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VIEWS, NEWS AND INTERVIEWS.

"In the early telephone days," said an old-timer, "we had some curious experiences. A doctor in Cincinnati ordered a telephone put in his front parlor. We sent a man to do it. He brought his wire in through the window frame. Not having a step-ladder handy, the fellow moved the piano around the room, and by placing a chair on top of it was able to attach his wire to the lower part of the frieze, near the ceiling, and carry it nearly around the room to the instrument. Our man came back and reported the 'phone installed. Next day the doctor called on our general manager.

"'I want you to send a paper-hanger up to my house, and get me a new piano,' says he.

"'What for?' says our manager.

"'Send a man up and you'll see,' says the doctor.

"I was sent out to investigate, and found the top of the piano ruined by chair-marks and the imprints of hobnailed shoes. The wall paper was adorned with a prominent frescoing of dirty finger-marks, and the job of wiring was a sight. We had to paper the room, do the wiring again and get a new top put on the M. D.'s piano. And in spite of numerous experiences of this kind, those were the halcyon days of easy money in the telephone business."

At the Stevens Institute of Technology a few days ago, Prof. Hiram Forbes stated that within the next half century two-thirds of the labor now done by men and women will doubtless be performed by electricity. "The toil of the agriculturist will be most materially lightened by this agent," said he. "The work of the manufacturer will be simplified and cheapened, household drudgery cleaned up and sweetened, and every department of human enterprise and effort materially helped."

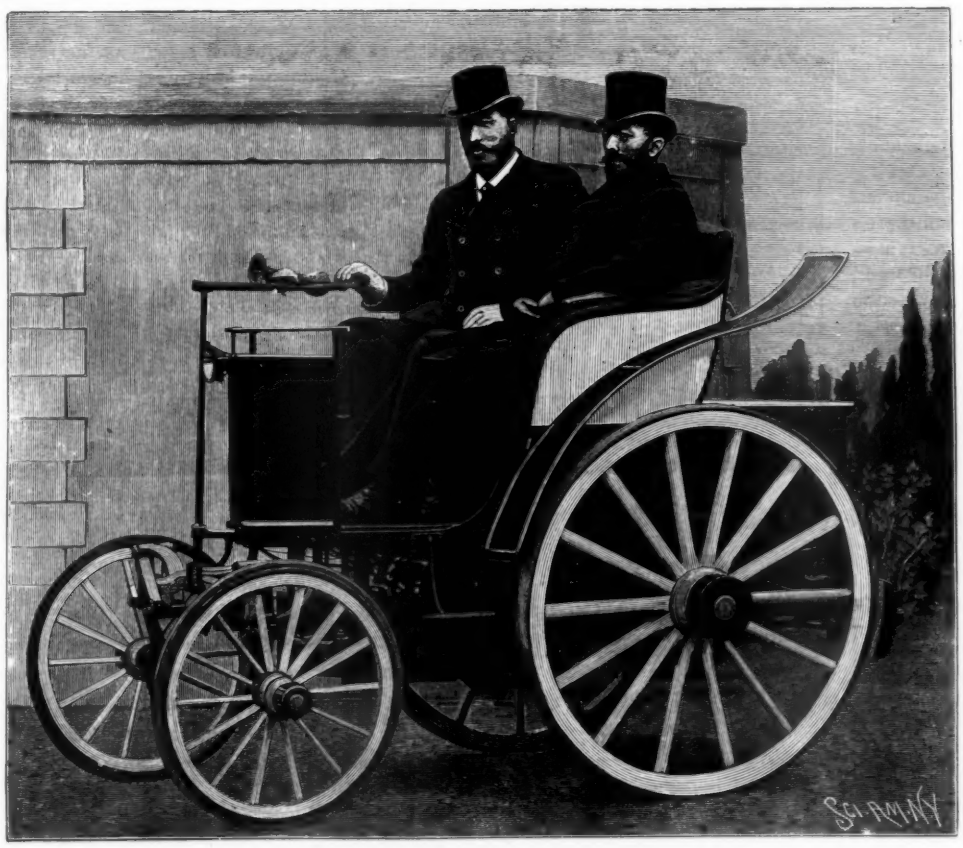
The Anglo-American Telegraph Company announces that on and after April 1 there will be a reduction in the rates to Zanzibar, Cape Colony and other places in South Africa.

An exhibition is to be held at Bordeaux, France, from May to November, 1895. There will be a special building called the "Palais de l'Electricité, which will be devoted solely to electrical apparatus and machinery.

There is said to be reason to believe that the trolley line from New York to Philadelphia will be completed, as valuable franchises have recently been secured, connecting important points of the system.

Miss Loie Fuller is reported to have made a great hit in Paris by a novel and ingenious adaptation of the electric light to skirt dancing. Beautiful effects are obtained by having large squares of plate glass let into the stage, under which different colored electric lights are placed.

Both houses of the Missouri Legislature have passed a bill providing that all municipal corporations in the State must sell all gas and electric franchises to the responsible bidder who will give the largest percentage yearly of gross receipts, in no case less than two per cent, for the first five years.



THE ELECTRIC CARRIAGE OF M. JEANTAUD.

Jeantaud's Electric Carriage.

During the Summer there will be a race between auto-mobile carriages in France. The course will be between Paris and Bordeaux. The race promises some interesting developments in the line of steam, petroleum and electric carriages. M. Charles Jeantaud, the head of an important carriage establishment of Paris, commenced experimenting on an electric carriage in 1881, when the accumulators of Faure first appeared, but at this time the dead weight of the accumulators was so great that M. Jeantaud was forced to stop his experiments; but he was spurred into activity by the recent success of petroleum and steam motors for carriages, and the result of his labors is the electric carriage which is shown in the accompanying illustration, for which we are indebted to the *Scientific American*. He found it necessary to obtain a source of electricity lighter and less cumbersome than those in use. He found it in the "Fulmen" accumulator. The plates are covered by a perforated celluloid envelope filled with the active material. In the center of this envelope are the lead plates which serve to collect the current. The celluloid is a perfect non-conductor and is not attacked by acids. The plates are carried in wooden receptacles, which are lined with celluloid. They are composed of two parts, the box proper and the cover, which is absolutely water tight and is transparent as well. The accumulator thus constructed presents a small bulk and light weight compared with its great capacity. It resists perfectly the shocks to which it is subjected. The batteries, which propel the car-

riage of M. Jeantaud, consist of 21 elements of the type just described, which give a current of 100 amperes of a pressure of 40 volts. In ascending slopes the current is increased.

The general appearance of the new carriage, as shown in the illustration, resembles that of a petroleum-propelled carriage. None of the actuating mechanism is in sight. The 21 elements are inclosed in seven small boxes, each containing three accumulators. These boxes are stowed away under the seat. The hands are free to steer the carriage and to control the speed; the switch, as well as the brake, is controlled by the foot. The foot is placed on the switch and the carriage starts with ease; on removing the foot the carriage stops and the momentum which it has acquired may be checked, if desired, by applying the foot to the brake. The brake is of the ordinary variety, a wooden shoe binding on the rear wheel. A circuit breaker is placed on the brake pedal, so that when the brake is applied the current is cut off at the same time. On a good level road a speed of 20 kilometres (12½ miles) per hour has been obtained, while in a hilly country the speed is reduced to 12 kilometres. The weight of the carriage is distributed as follows: Carriage, 490 kilogrammes; accumulators, 420 kilogrammes; motor, 110 kilogrammes; two passengers, 150 to 180 kilogrammes—total, 1,200 kilogrammes. As the kilogramme is equivalent to about 2.2 pounds, it will be seen that the carriage and contents weigh only about 2,645 pounds. The electric carriage has a future, and already in London there is a firm which displays a sign saying that they are prepared to charge accumulators of all sizes at any hour of the day or night. *L'Energie Electrique*, from which this description was translated, draws a glowing picture of France when the electric carriage shall have come into more general use, when travel in the vehicles, which move without the aid of steam or animal power, can be used for extensive trips, the accumulators being charged at any of the 10,000 establishments in France which have electrical plants.

KIND WORDS.

"WELL PLEASED WITH THE 'ELECTRICAL REVIEW.'"

To the Editor of Electrical Review:

I am well pleased with the Electrical Review and think it ought to be in the library of every person interested in the subject of electricity. G. R. R.

Kansas, March 27.

LIKES OUR EDITORIALS.

To the Editor of Electrical Review:

We telegraphed you to send us two dozen copies of your issue of March 20. Your editorial on the lamp situation is the most correct and sensible one that we have seen.

Yours very truly,
The Sunbeam Lamp Manufacturing Company,
F. S. Terry, Secretary.

Chicago, March 22, 1895.

NIKOLA TESLA'S LOST APPARATUS

ILLUSTRATIONS AND DESCRIPTIONS OF SOME OF THE INVENTOR'S DEVICES DESTROYED BY FIRE—HIS GOOD FORTUNE IN HAVING HAD PHOTOGRAPHS MADE OF THIS APPARATUS MORE THAN A YEAR AGO—THE "OSCILLATOR" AND ITS WONDERFUL EFFICIENCY.

Nikola Tesla some time since established his right to be known as the most promising electrical inventor of to-day. When on March 13 last his laboratory, his workshop and all its contents, and most of his important records were totally destroyed by fire, the loss was felt by every one familiar with recent electrical developments.

Tesla, although an extremely modest man, is very widely known through his achievements in pure electrical science and through the many articles that have been written about him and his work by lay and technical writers. The loss which he recently sustained was a most serious one and called forth expressions of sympathy from every side. It resulted in his receiving one of the highest compliments ever paid to any man. This was from the pen of Charles A. Dana, editor of the New York *Sun*, and a warm admirer of Tesla. Mr. Dana wrote as follows:

The destruction of Nikola Tesla's workshop, with its wonderful contents, is something more than a private calamity. It is a misfortune to the whole world. It is not in any degree an exaggeration to say that the men living at this time who are more important to the human race than this young gentleman can be counted on the fingers of one hand; perhaps on the thumb of one hand.

Immediately following the fire Mr. Tesla, instead of being prostrated by his misfortune, as reported in several daily newspapers, secured new quarters in which he began all over again the labor of years in the hope of reconstructing what had been totally wiped out. He is now busily engaged at this herculean task.

In view of the fact that Mr. Tesla's most important records were burned, it is extremely fortunate that the persuasions of Mr. Thomas Commerford Martin resulted in securing photographs of a number of pieces of apparatus which Mr. Tesla had developed and constructed more than a year ago. The illustrations which accompany this article were made from the photographs referred to. The half-tone plates were engraved at the time the photographs were taken, another fortunate circumstance, as the original prints were burned with everything else the Tesla laboratory contained.

Naturally, Mr. Tesla does not wish to have complete technical evidence of his work published abroad while he is in his present crippled condition, yet it is by his permission that these particulars are given here.

In the course of lectures, all too few in number, Mr. Tesla has at different times demonstrated before technical societies in this country and abroad a number of experiments wonderful in themselves and yet puny in comparison with the deep work of which they were but a feeble outgrowth. It has come to be pretty generally understood that the principal objects of Mr. Tesla's labors were the more efficient production of light, heat and power by electricity and the transmission of energy over long distances. His name is especially associated with the discovery of new phenomena resulting from his researches into the qualities and effects of high potential and high frequency currents. His first public lecture was based on these discoveries.

Since Tesla's discovery of the "rotating magnetic field" the long-distance transmission of alternating current from Niagara Falls has become possible. The basic idea of this discovery is to produce a circularly shifting magnetism instead of the well-known phenomenon of magnetism in a fixed position.

To the lay mind the most wonderful of all Tesla's experiments was the lighting of electric lamps or empty glass bulbs in free space, without any connection with the wires or generating apparatus. The light from these Tesla tubes is so intense that photographs taken by their illumination have been made with exposures of eight to 10 minutes.

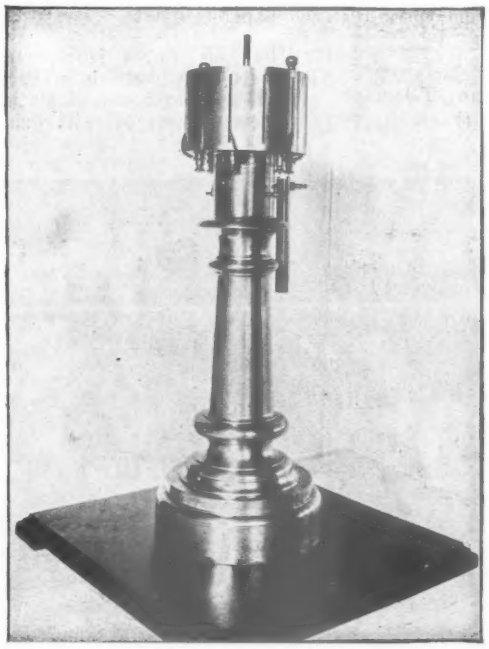


Fig. 1.—The Tesla Oscillator Shown at Chicago in 1893.

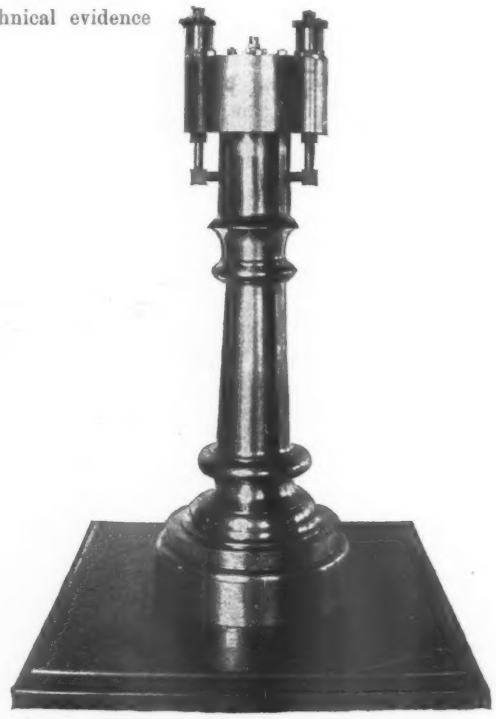


Fig. 2.—A Similar Form of Oscillator.

The wide field for improvement open to Mr. Tesla in his efforts to discover more efficient means of generating electrical energy may be better appreciated when it is stated that actual tests have shown that the energy manifesting itself as light in an incandescent lamp is less than five per cent of that received as current. The other 95 per cent is lost between the coal pile and the lamp. An important step in Mr. Tesla's labors to reduce this tremendous loss was the invention of his "oscillator." He reasoned that if large losses occurred in the steam engine and other large losses in the dynamo, it would minimize the combined losses if both machines were blended in one. And in the crudest terms this is what an oscillator is—an engine-dynamo.

In generating current by a revolving armature there is always some part of the wire winding which is doing no work, just as in the steam engine the steam cylinder and its

piston are the only parts doing any work, all the other complex mechanism being used for control or regulation. In brief and popular terms, the Tesla oscillator consists of a bedplate, in the middle of which is located

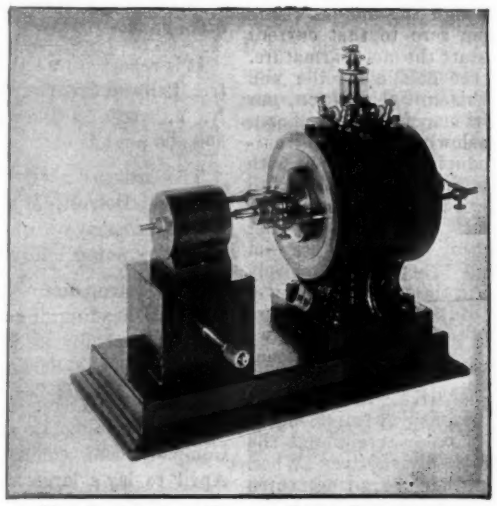


FIG. 3.—ANOTHER TYPE OF TESLA OSCILLATOR.

a steam chest. On each side of the steam chest is an electro-magnetic system consisting of field coils, between which the armatures move.

Two pistons are worked by the steam entering the chest. In one case steam at 350 pounds pressure is used, although as low as 80 pounds is used in other oscillators. At the ends of the pistons are the armature coils, which are thrust in and out of the magnetic fields with a reciprocating motion, thus generating current.

Here, then, is a steam engine stripped of every inefficient complication, and at the same time it is an electrical generator in which every part is doing steady work. The oscillator keeps the high pressure steam under such control that no packing is required to prevent leakage. For the same pressure and the same piston speed the engine part of the oscillator has but one-thirtieth to one-fortieth of the usual weight and consequently occupies a proportionately smaller space. The reduction of bulk and space occupied is also true of the electrical portion of the oscillator. Mr. Tesla believes that in the development of this apparatus he has reached a long way in advance in the reduction of the wasteful processes now present in the generation of electric current from coal.

The most highly developed form of oscillator, and one that was entirely practical and successful, had been used for many months in Tesla's laboratory. It was used to light the rooms with incandescent lamps and also furnished current for four arc lamps, for motors, for experiments with the high frequency apparatus and for other investigations. Many visitors to the laboratory have witnessed this oscillator in successful operation.

The oscillator which Mr. Tesla used in his lecture before the International Electrical Congress, during the World's Fair at Chicago, in August, 1893, is the only one that has ever been exhibited in public. This is shown in the accompanying illustration, Fig. 1. For convenience, compressed air instead of steam was used to operate this oscillator during Mr. Tesla's lecture. The machine consists of an engine mounted on an ornamental column, on top of which is a generator much like that shown at E in Fig. 6. In Fig. 2 is illustrated a similar form without the generator. A very strong air spring is contained in the box on top of the column. The apparatus is so constructed that the vibrations of this spring and the engine are always in perfect synchronism. The only possible function of the engine is to keep the spring vibrating. Eventually the amplitude of the vibration will be altered, but the period will remain the same; that is, it is the natural period of vibration of the system. The recoil of the spring is, of course, very much greater than the impulse received each time from the engine. Around the spring is a chamber which can be maintained at a constant temperature by any usual means. The isochronism is perfect because the frictional losses are infinitesimally small compared with the enormous elastic force.

Another quite distinct type is illustrated in Fig. 3. On a stand with a dynamo of somewhat unusual form is mounted a small oscillator. The dynamo includes a circular field magnet in which circular coils are arranged to move on each side. An arbor directly connected to the small engine carries the coils, and currents are produced by vibrating the coils within the field of the magnet. Mr. Tesla says that in this form there is absolutely no useless wire. All of it is within the field and all is equally active.

An oscillator of more advanced form, operated by steam and freely used for laboratory purposes, is shown in Fig. 4. This extremely small machine had a capacity of 12 incandescent lights. The combination was made up of a small oscillator and a dynamo having a field magnet with exciting coils and an armature simply of iron. The induced coils were wound on a number of pole projections extending from the inside of the magnet. The armature had fewer projections than the field and in this way the output of the dynamo was increased by the number of teeth.

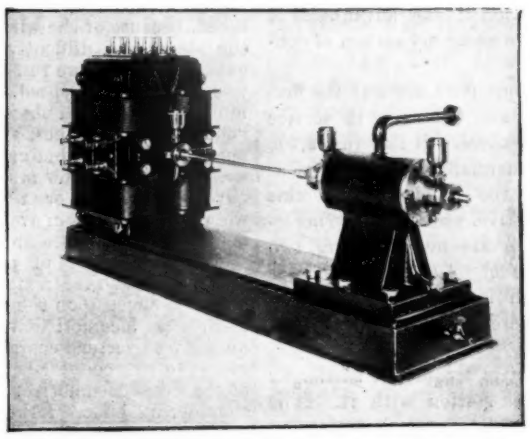


FIG. 4.—OSCILLATOR USED FOR LABORATORY PURPOSES.

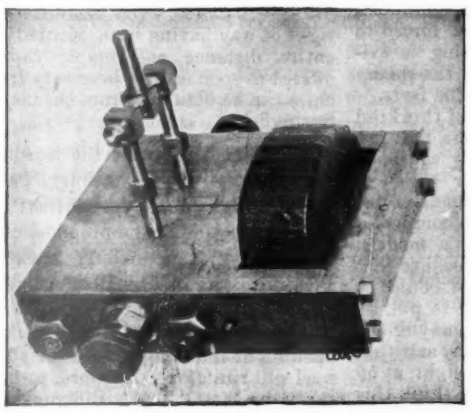


FIG. 5.—TESLA APPARATUS USED FOR SCIENTIFIC RESEARCH.

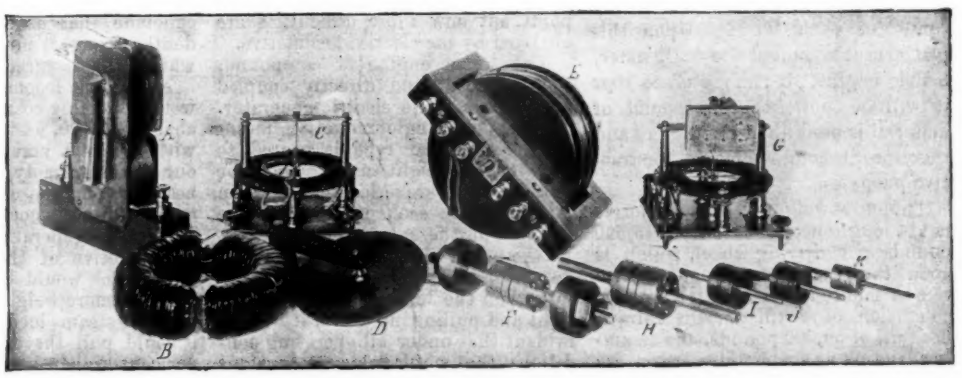


FIG. 6.—A GROUP OF PARTS OF TESLA APPARATUS.

An extremely interesting piece of experimental apparatus, used solely for scientific research, is shown in Fig. 5. It consisted of a field magnet within which there was arranged to vibrate a tongue of steel carrying at its end a coil. Both the tongue and coil were vibrated in the strong field, adjusting screws on each side allowed the attainment of any periodicity within a wide range.

A most interesting group of parts used by Mr. Tesla in his demonstrations is illustrated in Fig. 6. Novel features were exemplified by the use of several of the instruments shown. As an example, the magnets in A served to make clear the principle of the preponderance of one impulse over the other in the current produced by the oscillator and creating virtually the effect of a direct or continuous current. A magnet which was vibrated is shown in R. The copper disk D was arranged to rotate freely in bearings. When the disk was held between the poles, that is, in the field of the vibrating ring magnet, it was rotated in one direction. This showed that the currents distributed in the disk were asymmetrical, or in other words, they were preponderating in one direction.

The constancy or invariability of the speed of the oscillator was illustrated by the use of the little motor shown at C in Fig. 6. Another little motor with clockwork attached, shown in G, was used to count the revolutions of the oscillator. Both of these little motors were driven from one circuit, the difference of phase being obtained by artificial means. E was a little generator comprising three coils, two inducing and one induced, and an iron coil which was vibrated by the oscillator to which it was attached. The parts of an oscillator for short and long strokes, respectively, are shown in Fig. 6 at F, H, I, J and K.

These are only a very few of the Tesla devices which are now blackened ruins; yet they will serve to give a faint idea of the great and interesting achievements which this inventor has been accomplishing. Mr. Tesla is successfully at work reproducing his lost records and apparatus. The sympathy and encouragement he has received since his misfortune occurred will doubtless result in spurring him on to still greater and more brilliant efforts which an appreciative public will not be slow to recognize.

NOTES ON RECENT ELECTRICAL ENGINEERING DEVELOPMENTS IN FRANCE AND ENGLAND.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK AND CHICAGO, FEBRUARY 27, 1895, BY H. WARD LEONARD.

(*Concluded from page 169.*)

THE HEILMANN LOCOMOTIVE.

In France I examined what I considered the most important electrical engineering development of all that I saw. It was the Heilmann electric locomotive. Having been for some years past a firm believer in the merit of this machine, and having been in correspondence with Mr. Brown, Mr. Heilmann's electrical engineer, as to an invention of mine used in this locomotive for the first time on a large scale, I was especially interested in it, and my hearers will please discount as they may think necessary my description of the advantages of a locomotive using my system of control.

The locomotive I saw was the first one built, and was not in service when I was there. It had run 2,200 miles commercially, however, and as a result of the performance of this first locomotive, which was 600 horse-power, there are now building two locomotives of 1,500 horse-power each, which it is expected will go into commercial service about June next.

This electric locomotive carries its own central station with it. It is really a complete central station on wheels, with its power used for propelling itself. Speaking from memory, I should say the length over all was about 50 feet. The locomotive is mounted upon two bogies, each having four axles, so that the weight of the locomotive is borne by 16 wheels, each of which is about 45 inches in diameter. A platform made of heavy iron girders runs the whole length of the locomotive, and is supported upon two pivots, one at the center of each bogie. Upon this platform is mounted the coal, water, boiler, engine, dynamo, etc., so that it will be noticed every pound of material is used upon the drivers and therefore becomes effective for tractive purposes.

The entire weight of the locomotive is 114 long tons; that is, about 15,500 pounds per driving wheel, which is about the same as our standard practice in this country. With a tractive co-efficient of .2 this means a draw-bar pull of 50,000 pounds, and assuming friction at six pounds per ton, we find that 50,000 draw-bar pull would enable us to pull 1,900 tons on a one per cent grade at a low speed, say 15 miles per hour, and would give us ample draw-bar pull for handling a 200-ton train at any speed thus far seriously discussed.

Most engineers who have heard of the Heilmann locomotive have derisively dismissed it from their minds as a ridiculous monstrosity of a crazy Frenchman, but I have for some time believed, and am now convinced, that you will, in the immediate future, be bound to give this machine the most respectful consideration. I find that the impression prevails generally that the modern steam locomotive is really a very perfect and efficient machine. This, I think, is far from being true. The efficiency of a boiler depends largely upon how perfect the combustion is, and with forced draft we can realize an efficiency of 80 per cent with very perfectly designed boilers, provided we do not attempt to burn more than about 40 pounds of coal per square foot of grate surface per hour. But the maximum duty of boilers in locomotive practice, such as for the highest speed service, involves the use of nearly 200 pounds of coal per square foot of grate surface, and I need hardly say that forcing the boiler in this way results in a terrible inefficiency. To produce an indicated horse-power in a steam locomotive at highest speeds to-day probably requires at least twice as much coal as is required in first-class stationary or marine boilers. This is the first place where Mr. Heilmann is able to show an economy. He is able to carry a larger boiler and, hence, does not have to crowd it to such a wasteful point.

But, regardless of an abundant supply of steam from the boiler, we find ourselves greatly limited in power for steam locomotive practice at high speed, because of the wire-drawing of the steam and difficulty of properly exhausting when we run our locomotive at its highest speed. The maximum draw-bar pull obtainable, when running at the highest speed, is only about half that obtainable at slow speed, no matter how much steam we have at command or at what cut-off we work. Heilmann avoids this difficulty as we shall see presently.

Another matter of most serious importance is the tremendously destructive effect upon the roadbed and upon the locomotive itself of the unbalanced vertical component of the motion of the counter-balance weight of the steam locomotive, and also the shouldering effect of the locomotive tending to spread the rails. Probably, at least, one-third of the cost of maintenance of the roadbed and the locomotive for high-speed service could be traced directly to this destructive "hammer blow" and side thrust. Both of these effects, which become very troublesome as we go to the higher speeds, are entirely absent in the electric locomotive.

Having now pointed out the weaknesses of the steam locomotive which develop most forcibly as we increase in speed, I will describe the construction of the Heilmann locomotive and point out how those difficulties are obviated by the electric locomotive.

The steam engine is compound, well-balanced, and directly coupled on its shaft is the electric generator. A four-pole single reduction motor of the iron-clad type is geared to each of the eight axles, and the motors, which are series wound, are in multiple with each other across the brushes of the generator armature. As the motor field must have a fair degree of saturation to prevent sparking when the locomotive is running light and pulling no train, it will be evident that under all operating conditions the motor fields are constant and fully saturated, which makes them entirely sparkless. The field of the generator is separately excited by means of a small auxiliary engine and constant potential dynamo, which also supplies the electric lights needed. The main engine has a fixed cut-off at the most economical point, say one-quarter stroke, and its speed is adjusted by the throttle.

The engine in practice is varied in speed from perhaps 50 to 500 revolutions, and the strength of the generator field from zero to its maximum strength. It will be noticed that all steam used is used expansively at a fixed cut-off, and Mr. Heilmann lays great stress on this, although I myself would prefer an automatic engine running at a constant speed, and I believe that he would if he could get as good ones abroad as we can in this country. For starting, an almost unlimited torque is secured by gradually increasing the generator field strength and speed, which sends a current through the motors, rising smoothly from zero to that current sufficient to start the motor armature. If we leave the field controller and throttle in this initial position, our train will start smoothly and will continue to move slowly, using the full current, but producing the current with about 50 volts, or one-tenth of the full voltage, and we will be producing this power, about one-tenth of that required at full speed, by a steam engine using steam expansively instead of, as in the steam locomotive, full stroke. But, of course, we desire to accelerate the train rapidly, so we keep on manipulating the field controller and throttle, until we finally have the engine driving the generator at full speed in a field of full strength, which will, of course, represent the full power of the locomotive. When we reach a grade requiring three times the torque required on the level, we weaken the field to one-third of its full strength. We will then move up the grade at about one-third of the speed on the level, while using the same power as was required on the level.

It will be noticed that under the electrical arrangement on this locomotive the electric energy is used in such a manner that its voltage is varied in proportion to the speed desired, and the amperes are in proportion to the torque required, so that the electrical energy produced is utilized in the most efficient manner possible.

Since this method of control of mine has been repeatedly criticised before this Institute on the score that a generator of such size and type when used as described would spark disastrously, I beg leave to say that I scrutinized most carefully the commutator of the generator which had supplied the current during the locomotive's 2,200 miles' service, and I never saw a commutator and brushes in more perfect condition, and the engineer assured me that under no circumstances had there been any sparking whatever. I regret that my method of control does not fit the generally accepted self-induction theory of sparking, but am forced to conclude that as something is evidently wrong, it must be the theory which fails to agree with the facts.

An electric locomotive of this kind would probably cost for the first few about $30,000, each being equipped with a 1,500 horse-power boiler of our best marine type, and one of our best automatic cut-off compound engines directly coupled to a modern multipolar generator. I believe that a locomotive of this type could be built which would be able to pull 50 per cent more weight than any of the present steam locomotives, and that it could pull the same weight at 50 per cent higher speed. I think this type of electric locomotive is the stepping stone between the steam locomotive and the electric locomotive operated from a distant central station.

To properly try the experiment of operating a high-speed locomotive of 1,500 horse-power from a central station would undoubtedly cost nearly a million dollars. To try it with a locomotive of the Heilmann type would cost not more than $50,000, and if it proves successful it is not much of a step to replace the boiler and constant speed steam engine with the moving contact and constant speed electric motor for driving the generator already tested and proven satisfactory.

ELECTRIC RAILWAY NOTES.

Officers of electric railway companies are requested to send promptly to the ELECTRICAL REVIEW *notices of meetings, election of officers, declarations of dividends, financial reports and all items of interest in connection with the financial and practical operation of their roads.*

It is reported that the Nassau Electric Railway Company, of Brooklyn, N. Y., recently placed an order for 500,000 pounds of copper wire.

The Citizens' Street Railway Company, of Detroit, Mich., have purchased property on which to build a large new power house.

The Metropolitan Electric Company at Reading, Pa., have placed the contract for their new power house with the Berlin Iron Bridge Company, of East Berlin, Conn.

The Springfield, Ohio, Railway Company will commence early in April to lay a large amount of new rail. They will also add another engine and generator and increase their boiler capacity.

The Queen City electric railway at Marion, Ind., has been sold by the receiver to the Marion Street Railway Company. The road originally cost $53,000, and the indebtedness was about $75,000. The purchasing company paid $30,000.

A plan is on foot to build a trolley road across Long Island from Port Jefferson to Patchogue. It is proposed to organize a company with a capital stock of $150,000. The question was discussed last week at a meeting of citizens in Port Jefferson, and it was believed that it would be feasible to carry freight as well as passengers. A committee was appointed to solicit subscriptions.

Arrangements have about been completed for a new street railway in Springfield, Ohio, embracing the three State homes—Masonic, Odd Fellows and Knights of Pythias. It is also intended to extend this line northward to Urbana, Ohio, 15 miles, the right of way having been secured the entire distance and ample capital offered as soon as the necessary franchise can be obtained from the city of Springfield.

President Shaffer, of the Seashore Electric Railway in Asbury Park, N. J., has given out the contract for the construction of the proposed electric railway from Asbury Park to Pleasure Bay. Work will be begun in a few days, and it is expected that the line will be in running order by the opening of the Summer season. The road will run along the shore, passing through West End, Elberon and Long Branch.

The total number of passengers carried by the street railways of New York city for the year ending June 30, 1894, was 246,226,197, an increase of 3,500,000 over the preceding year. Estimating the number of passengers carried by the Manhattan Elevated Railway for the fiscal year of 1894 at 218,000,000, the total number of passengers carried by elevated and surface roads in New York city is equal to 80 per cent of all the passengers traveling by steam railroads in the United States

The M. & B. Telephone Company's System.

The M. & B. Telephone Company, a recent new-comer in the telephone field, has established headquarters in the Bullitt Building, Philadelphia,

FIG. 1.—M. & B. DESK SET FOR LONG OR SHORT-DISTANCE WORK.

and has developed a system which is illustrated and described herewith. This company owns a fundamental patent for the transmission of speech by the "make and break" method, which, in connection with numerous construction patents, gives them a complete system peculiar to itself and one which is claimed to be non-infringing, since the principle employed is diametrically opposed to that of the Bell system or any of its imitators. The method is protected by a patent granted in 1887. The M. & B. Telephone Company, by taking the broad ground of claiming to control what is said to be a non-infringing method, hope to prove by the perfect working of their transmitter that the claim that articulate speech cannot be transmitted except on a closed circuit cannot be upheld. Furthermore, they claim that better results are obtained by the M. & B. transmitter than have ever been obtained by any closed-circuit transmitter of any type.

The M. & B. Telephone Company are making various standard sizes of instruments for interior work, as well as a standard long-distance telephone, made especially for first-class exchange service. In interior work and short line service, as between house and stables, or connecting a small number of houses or buildings together, they make a specialty of designing instruments, suitable for this purpose, with switching devices protected by broad patents controlled by them. In the fitting up of hotels, office buildings and private houses, they have standard instruments already designed, or they will design them to meet the requirements of the case in point. They may be finished in hardwood to match the woodwork of the dining room, or in white and gold for the parlor, while plainer sets are designed for use in the stable, kitchen and elsewhere. They will make a specialty of getting up apparatus to meet the requirements of architects, builders or individuals.

The M. & B. transmitter is claimed to be the simplest yet devised. A carbon sphere rolling on an inclined plane, with a suitable contact point attached to the diaphragm, is the principal feature of the transmitter. With every vibration of the diaphragm a complete make and break is made between the point and the sphere. It has been demonstrated by actual tests that this transmitter is as well adapted for long as well as short-distance work.

FIG. 2.—M. & B. EXCHANGE TELEPHONE WITHOUT BATTERY BOX.

The M. & B. Telephone Company say they are prepared to supply a complete telephone exchange, including a metallic or grounded circuit switchboard that is guaranteed as to the patent question and that can be worked with one-third the number of operators usually employed. Their standard exchange M. & B. telephone is fitted with a receiver hook, claimed to be broadly covered by patents, which is a novel feature and of great assistance in making a complete exchange. When the subscriber rings up "central" on this system, a few turns of the handle of the magneto automatically removes his ground, and his bell stops ringing. On taking the receiver from the hook, the hook retreats into the magneto box. When the subscriber is through talking, he cannot put his receiver up until he has rung off, for the reason that the hook remains out of sight until the ringing of the magneto automatically brings it into view again. This prevents the subscriber forgetting to ring off, and goes a long way towards insuring the best possible service in an exchange.

One point of superiority claimed for this switchboard is that a board with a capacity for 1,000 subscribers occupies a space of only two feet high by six feet long. Another point claimed is that it is the quickest board to operate, as one operator can handle three times as many subscribers as on any other. It is claimed to be impossible to burn out the board either by electric light, railway or lightning currents. Perfect secrecy is another advantage claimed, owing to the fact that the "central" operator cannot cut in on a subscriber or listen to his conversation. The M. & B. switchboard can also be installed as a grounded circuit board, and can be easily changed over to metallic circuit by running another wire to the subscriber. This company is also prepared to furnish a toll line switchboard for use between cities and towns.

The company have recently moved into their factory at Germantown, Pa., but still maintain their laboratory and testing department on Third street, Philadelphia. They have ample facilities for turning out apparatus, and are establishing agencies in the principal cities and States throughout the United States.

In the United States Circuit Court at Trenton, N. J., on March 29, a

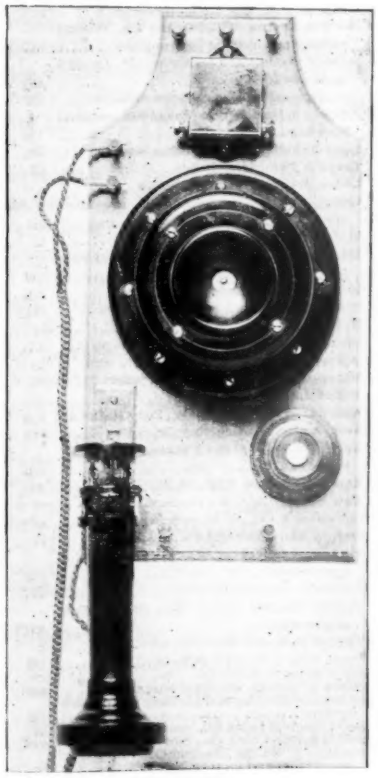


FIG. 3.—M. & B. PUSH BUTTON SHORT-DISTANCE TELEPHONE.

jury gave a verdict for $10,000 damages to Henry M. Gardner against the Newark Electric Light and Power Company. Gardner is the administrator of the estate of James A. Mason, a telegraph lineman employed by the Pennsylvania Railroad Company. Mason was killed in Newark on the morning of April 26, 1894, by stepping upon an electric light wire while at work on the railroad company's line. Suit was brought for $25,000, and the case was taken to the United States Court, because the administrator is a non-resident. The testimony showed that Mason had been standing on an electric light wire and was grasping with one hand a telephone wire that was grounded. The Newark company will carry the case to the United States Circuit Court of Appeals.

ITEMS OF INTEREST.

A complete system of interior telephones will be put into the New York Post Office. It is intended to bring all the heads of departments throughout the building into immediate and direct communication with Postmaster Dayton's office. The switchboard has 50 drops. In conjunction with this system is also a speaking-tube system.

The Telegraphic Historical Society of North America, which was organized at Washington, D. C., on the 5th of last December, has determined to mark with a suitable tablet the site of the old depot of the Baltimore and Ohio Railroad on Pratt street, Baltimore, opposite the Maltby House, from where the first telegraphic message was sent over a wire. The site is now occupied by a cracker factory. The tablet is to be of bronze, and of the most artistic design that can be obtained. The first message was sent from that location to Washington on the 24th of May, 1844.

The New York Insulated Wire Company last week obtained an attachment for $35,397 against the Westinghouse Electric and Manufacturing Company of Pittsburgh. Later in the day the Westinghouse company gave bonds for $40,000, furnished by Brayton Ives and Marcellus Hartley, and the attachment was vacated. The claim grows out of a dispute over a contract for wiring work at the World's Fair in Chicago, in June, 1892. The Westinghouse company obtained the contract and

FIG. 4.—M. & B. "BABY" TELEPHONE FOR HOUSE WORK.

gave the sub-contract to the New York Insulated Wire Company, which did all the wiring work between the fixtures and dynamos. It is claimed that the Westinghouse company received $260,719 from the World's Columbian Exposition and paid to the New York Insulated Wire Company $229,329. The latter company also included a small claim for extra work done.

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We call especial attention to the article in this issue on Nikola Tesla's apparatus, which was destroyed by fire on March 13 last. The photographs from which our illustrations were engraved over a year ago were lost in the flames, and had not the engravings been made at the time, there would be no graphic record of some of these wonderful devices in existence to-day.

THE GÜLCHER THERMO-ELECTRIC BATTERY.

On another page of this issue of the ELECTRICAL REVIEW will be found an interesting report of some tests on the Gülcher thermo-electric battery. These tests are especially interesting on account of the scarcity of accurate data with regard to the commercial efficiency of the best thermo-electric batteries. In the Gülcher cell, the maximum useful output, which is approximately 10 watts, is attained at a discharge rate of about 2.5 amperes and with a consumption of 5.79 cubic feet of gas per hour. With gas at a dollar per thousand this would mean about 43½ cents for gas per horse-power hour. To this figure, of course, would have to be added the interest on first cost and the depreciation, and as it would take about 75 of these cells per horse-power, these latter items would probably become important. Nevertheless, it would seem that there must be a wide field of usefulness for good batteries of this description where small power is required at a lower tension than that at which current is usually distributed for lighting and power purposes, and where primary batteries have been used to advantage. Such a battery could not compete successfully, however, with a storage battery charged from power mains by means of a motor generator, as a horse-power hour can be obtained by this means at a very much smaller expense.

We describe in this issue what appears to be a very successful electric carriage. It is a French product and the maker, M. Jeantaud, seems to have devoted considerable time to its development. It will not be long before our livery stables will be obliged to have electric carriages on hire in order to meet the competition in their business caused by the large increase in the number of bicycle riders.

The New York Central & Hudson River Railroad is to be congratulated on its progressiveness in deciding to equip with electricity its line between Buffalo and Niagara Falls. Where a railroad has a short line devoted largely to excursion traffic, requiring the operation of a large number of trains at moderate speeds, there is nothing better than an electric equipment.

Are the hard times over? We guess they must be. Here's an electric railway project, hatched in Chicago, that asks for subscriptions to $200,000,000 capital stock.

WALL STREET AND THE ELECTRICAL STOCK MARKET.

The upward movement in prices in Wall street during the week which has just closed was entirely warranted by an improvement in business conditions. It was not the spontaneous outgrowth of those factors, however, but required some little artificial stimulus in order to change the sentiment, which had been pessimistic so long that it had grown chronic. This was furnished by the bond syndicate, which in one way and another exerted its powerful influence, brought about an advance of some 3 points or more, and later, when realizations set in, stood under the market, taking securities offered, thereby establishing prices on a higher plane. Reports of higher prices and an improved demand for coke, iron, steel, leather, dry goods, boots and shoes, and the sustained improvement in those products which furnish vast areas with purchasing power, viz., wheat and cotton, have all had their effect upon trade and sentiment. The man who believes that the country is going to the dogs is now in the minority. A greater volume of trade is shown in increasing bank clearances and railroad earnings, and is resulting in many sections in an increased demand for money at higher rates.

The one great topic of interest in Wall street was the deal between General Electric and Westinghouse in the matter of patents, which it is now firmly believed in well-posted electrical circles will extend to prices and have the effect of virtually creating a monopoly within certain prescribed limits. The deal is one of the effects of the operations of the bond syndicate. Messrs. Morgan and Belmont, the one largely interested in General Electric, the other in Westinghouse, were brought close together by the government bond transaction. A part of their contract was to keep down gold exports. To do this a restoration of confidence along all lines was necessary. Consequently it is but natural that they should employ every legitimate means to the end in view. The two great companies in question had been operating at cross purposes and it was most natural that they should stop useless litigation, which has cost over $1,000,000 a year, if by so doing it would help attain the general object of their owners and at the same time further personal ends.

Those in a position to talk say that while the deal involves the question of prices, that it in no sense can be construed as foreshadowing high prices. The managements will not invite competition by such a policy, but will keep their rates down to a fair profit margin.

Wall street has generally accepted as true this change in General Electric affairs, has largely covered its short interest in the stock and, to a considerable extent, purchased the stock for a speculative turn. The highest price was 37⅞, recorded on Monday. Since that date the stock has sold between 35 and 36½, and has been fairly strong. Transactions were of

unusual volume. The 5 per cent debentures on Monday advanced to 91⅞, and later sold at one point under that figure. The preferred stock touched 70 and later sold at 67.

The Postal Telegraph Company, at a special meeting held this week, authorized an increase in its capital stock from $10,000,000 to $15,000,000. The increase is to be used in extending the service and in payments for extensions already made, the moneys for which were advanced by John W. Mackay. The stock is bid at 64½.

The Edison Electric Illuminating Company of New York sold from 95 to 99¾ in a limited way. The bonds sold at 106¼ to 106½. The company will shortly bring out a new financial plan, which will involve an authorization of 15 million dollars of 5 per cent bonds. Of this amount $4,312,000 will be held to retire the outstanding first mortgage 5's. The new mortgage will provide that at no time shall the total issue of bonds exceed the outstanding volume of stock. Consequently the new issue cannot exceed $3,650,000 of bonds in excess of the amount now outstanding. A portion of this sum will be used to convert bonds and other obligations of the Manhattan and Harlem companies controlled by the Edison.

On the Boston Exchange, Bell Telephone showed strength early in the week, being bid 196 and held at 197. Later it was offered at 194½. Electric Storage sold at 29. Erie Telephone was bid 50½ and held at 51½. New England Telephone was strong at 71, an advance of 1 per cent. Westinghouse securities were unusually strong. The common was 36 bid and 36¼ asked; the preferred 52 bid and 52½ asked.

The New York & New Jersey Telephone Company listed on the New York Stock Exchange this week $350,000 of its general mortgage bonds, making the amount outstanding $1,289,000.

The Mexican Telegraph Company, for the quarter ending December 31, shows a balance surplus after dividends of $20,926.

The surplus earnings of the Central & South American Telegraph Company for the quarter ending December 31, after dividends, were $55,770.

BAIN.

New York, March 30, 1895.

IN TESLA'S LABORATORY.

BY ROBERT UNDERWOOD JOHNSON.

[*From the Century Magazine.*]

Here in the dark what ghostly figures press!—
No phantom of the Past, or grim or sad;
No wailing spirit of woe; no specter, clad
In white and wandering cloud, whose dumb distress
Is that its crime it never may confess;
No shape from the strewn sea; nor they that add
The link of Life and Death—the tearless mad,
That live nor die in dreary nothingness.

But blessed spirits waiting to be born—
Thoughts, to unlock the fettering chains of Things;
The Better Time; the Universal Good.
Their smile is like the joyous break of morn;
How fair, how near, how wistfully they brood!
Listen! that murmur is of angels' wings.

Cost of Central Station Storage Batteries.

TO THE EDITOR OF ELECTRICAL REVIEW:

It is with considerable temerity that I offer again to the public my views upon any subject, after reading in your last issue the authoritative opinion of Mr. Herbert Lloyd that Mr. Perry is not a man of ordinary intelligence, and that his statements are not only ridiculous, but *false*.

Mr. Lloyd clinches his argument by stating that I cannot distinguish the difference between a horse-power and a horse-power hour.

This leaves me without a leg to stand on, but while admitting my weakness and that I am no match for Mr. Lloyd in gentlemanly controversy, acknowledging a complete knock-out, I still beg to re-state my position.

In the preparation of my paper, read at the Cleveland Convention of the National Electric Light Association, all available information was gathered as to the original cost and expense of maintenance of central station storage battery plants, both here and abroad. Most of my conclusions were based on figures given by the Electric Storage Battery Company, of Philadelphia, of which Mr. Lloyd is the general manager. I believed them to be essentially correct.

Among other things Mr. Lloyd charges that my figures of original cost were too high, and that his company are willing to take contracts at much lower rates. If Mr. Lloyd will now publish this revised price list, with discounts for plants of various capacities, and with the specific guarantees which his company will make for each, I should regard such statement as authentic, and gracefully acknowledge my error, if his prices proved to be lower than those given by me. It is on record that the price on one plant sold by Mr. Lloyd's company since the Cleveland meeting was *higher* than the price assumed by me.

Mr. Lloyd still clings to the idea that Mr. Edgar's statement in regard to the battery plant purchased by the Boston Edison Company refutes my views and substantiates his position; whereas Mr. Edgar's explanation was accepted by every intelligent central station man at the Cleveland meeting as *proving* that the only place for a battery plant in central station service is in taking the peak off the load line.

This was and is my exact position.

Yours very truly,

NELSON W. PERRY.

New York, March 30, 1895.

People interested in the construction of the new telephone line from East Bangor to Wind Gap, Pa., inform us that the work will be begun at once. Fifty subscribers have joined together to build the line, each contributing $12.50, and will receive their service for $1 per month. Those who come in later will be charged $1.50 per month. It is expected that the line will be in operation within 30 days.

Vevay, Ind., is agitating the question of electric lights.

Argon and Helium.

A special cable dispatch to the New York *Sun* from London under date of March 30 says that the detection of the gas argon in the atmosphere is being followed by a rapid series of discoveries of great interest. Chemists have long known, theoretically, of the existence of another element which has been called Helium, and which was revealed by the spectroscope in the sun's rays. It was not known to exist in this planet. Professor Ramsay a few days ago, in order to find whether there was something in the world with which argon would keep company, was examining an extremely rare earth found in Norway and known as Cleveite. When this mineral is treated with weak sulphuric acid it gives off a gas which has hitherto been regarded as nitrogen. The professor found by close examination that it was not nitrogen, but argon, and, moreover, there was associated with it another gas which he found to be, to use his own words, gas which had not yet been separated. He submitted it to Professor Crookes, and the result is to show that the gas thus found is Helium.

M. Berthelot, continuing his experiments in Paris, found that in manipulating argon he developed at an ordinary pressure a magnificent fluorescent substance greenish yellow in color and characterized by a spectrum similar to that of the Aurora Borealis. From this he deduced that the northern lights are caused by fluorescent matter derived from argon and engendered through the influence of electrical emanations developed in the atmosphere.

Still another scientific triumph of the past week is the liquefaction of hydrogen by Prof. Olszewski, of Cracow, Professor Dewar's rival. He finds that the lightest of all gases liquefies at 243° below zero.

Electricity on the New York Central.

The New York Central & Hudson River Railroad will introduce the trolley system on its road between Buffalo, N. Y., and Niagara Falls in the near future. Estimates for the change have been prepared, and when the plans are all ready definite action will be taken. The idea was suggested by the proposed paralleling of the road by a trolley company. The officials of the Central at once thought that if a new company could build and equip a road and make money there was no reason why the New York Central, with its fine roadbed, stations and appliances, could not make the change at a profit. Electric power will probably be obtained from Niagara Falls.

The British ship "Pathan" arrived at New York last Saturday and reports a curious experience with lightning. During a gale in low latitudes two weeks ago a bolt of lightning struck her foretopmast just under the truck. It didn't splinter the mast like an ordinary bolt, but burned right through it like a red-hot poker, making a three-inch hole, running aslant through the mast.

$200,000,000 Capital!

The Inter-Ocean Electric Railway Company was incorporated with a capital of $200,000,000 at Springfield, Ill., on March 30. Chicago, New York and San Francisco capitalists are said to be interested in the company. The alleged intention is to construct an elevated electric freight railway between Chicago and New York for the transportation of coal and grain. The plans and specifications have been drawn by a Chicago engineer, and the company will own a number of patents on electrical devices used by the road. The first section of the road will be built between New York and Chicago, and the running time of freight trains will be one day instead of six days as is now sometimes the case. The road will have its own telephone lines, and it is proposed in time to extend the line to San Francisco. The company's principal office is in Chicago, and the commissioners to open books of subscription to the capital stock are James G. Hulse, Parker Crittenden and John W. Hill, all of Chicago. The duration of the corporation is 99 years.

PERSONAL.

Mr. U. N. Bethell, general manager of the Metropolitan Telephone and Telegraph Company, is enjoying a few days' vacation at Virginia Beach, Va.

Charles W. Hoadley, of New York city, has resigned his position as Master Workman of the Electrical Workers' Union.

Mr. George B. Muldaur has resigned the associate editorship of the *Electrical Engineer* and has accepted a position on the staff of the New York *Evening Sun*.

The Auto-Telephone System.

The Tucker Electrical Construction Company, of New York city, licensees of the auto-telephone system, have issued a public notice to the effect that they have brought suit against the Interior Telephone Company for the alleged infringement of a patent on carbon powder used in the transmitters of the auto-telephone system. The Tucker company offer protection to their customers in the matter of patent litigation.

Arrangements have been completed by which the Kings County Elevated Railroad, of Brooklyn, N. Y., can make connection with the Brighton Beach road, thus giving a through connection from the Brooklyn Bridge to Coney Island. Several improvements in both roads are contemplated. Among these is a probable change from steam to electricity. In course of time, probably before the close of the coming summer, there may be trolley cars running to Brighton Beach on five or six minutes' headway.

The New England Telephone and Telegraph Company has declared a quarterly dividend of $1 per share (one per cent), payable May 15. Transfer books close April 4 and reopen May 7. It declared 75 cents per share a year ago, but the three subsequent quarterly dividends have been $1 per share. The present year promises to be an excellent one, in a business sense, for this company.

THE NEW YORK STATE TELEPHONE BILL AGAIN.

SOME CRITICISMS OF MR. STERNE'S LATEST PAMPHLET.

After last week's ELECTRICAL REVIEW had gone to press we received, presumably in common with other telephone subscribers, a pamphlet entitled "The Telephone Bill, 1895, Senate Bill No. 18, introduced by Mr. Persons; Assembly Bill No. 241 introduced by Mr. Gerst. Argument on behalf of the Bill by Simon Sterne, Esq., representing the New York Board of Trade and Transportation and other commercial bodies."

The pamphlet contains, according to the list of contents printed on the cover: "Synopsis of Mr. Sterne's speech, February 5. Speech of Mr. Sterne in reply to General Tracy and others of counsel for Telephone Companies, February 19." It is accompanied by a copy of the amended bill, a circular asking for contributions of money from telephone subscribers and a blank form of petition in which people are coolly asked to sign their names to a statement that "the bill will afford liberal returns upon honest investment and is so just and fair in its provisions that it should at once receive the sanction of the legislature." There is no qualification of this flat-footed assertion. You are not asked to say that you "believe" so and so, but to say that it *is* so. If any recipient of this interesting collection of printed matter has the patience to struggle through the jumble of brackets and italics that the amended bill is made up of, and to compare the rates laid down therein for cities in New York State with the rate obtaining in other American cities, as shown in the appendix to the Sterne pamphlet, he certainly will hesitate to sign the petition. On the showing made by the supporters of the bill themselves the rates in cities of other States range from 100 to 200 per cent higher than the rates they propose to allow the companies in New York State to charge. There is nothing "just and fair" about that, and such a comparison opens up the inference that the bill will *not* "afford liberal returns upon honest investment." However, it is not the bill that we want to discuss, for, as a practical measure, it is, as we have hinted before, really beneath discussion. It is rather to the "arguments" of Mr. Sterne that our attention is once more attracted.

In the first place, it seems from the pamphlet edition of Mr. Sterne's speech, which differs widely from the New York *Times* report that we previously quoted, that he discovered, after his fulminations before the committee about the London system of 35,000 subscribers, that he had made "an error in his computation" and that the subscribers in London are less than 8,000. A strange and humiliating discovery for an expert on international telephony of several years standing, and it is not to be wondered at that Mr. Sterne got out of it as best he could by writing to the committee and to the opposing counsel, but omitted to write to the newspapers that published his speech. In the pamphlet edition of the speech Mr. Sterne crawls out of the awkward situation he had created for himself with truly legal skill and subtlety. He explains in peculiarly involved language in a footnote (for which, as the whole speech has been rewritten, there was no necessity), that he made a mistake about the 35,000 subscribers and that he has ascertained the subscribers in London "to not be in excess of 8,000." "Hence," says Mr. Sterne, "the answer to the position of the telephone company based upon the supposed difference of numbers between London and New York lacks pertinency (*sic*)." In order to divert attention from this confession of ignorance, Mr. Sterne goes on as follows: "If the London company can afford to render the service at an average rate of less than $100 to its subscribers, covering with its wires 730 square miles, why cannot the New York company render the same service within a tenth of the area, requiring but 10 per cent of wire and presumably local exchange service (*sic*), especially when the London company pays the same royalty, and in addition pays 10 per cent to its government for the privilege of doing the business."

Certainly no fledgeling reporter working up a column to tack on to a "display" heading could perpetrate greater nonsense than is contained in the foregoing quotation. "Why cannot the New York Company render the same service within a tenth of the area, requiring but 10 per cent of wire and presumably local exchange service." If that sentence means anything it means that the London system requires 10 times the amount of wire in the New York system. The New York system has 30,000 miles of wire, so the London system must have 300,000 miles. Mr. Sterne has ascertained the London subscribers "to not be in excess of 8,000" so it follows that the average length of line is 37½ miles per subscriber, and this would bring the average London rate at £20 plus £2 10*s.* per half mile over one mile to something over £200, or $1,000, which, of course, is no nearer the mark than many other of Mr. Sterne's statements. As to the expression "presumably local exchange service" it simply means nothing at all. Mr. Sterne might have had something vaguely in his mind when he compiled it—perhaps that as New York is not spread over so large an area as London, New Yorkers do not telephone so much as Londoners. If that was what was in Mr. Sterne's mind, he was wrong again, because the average traffic of the New York subscriber is more than double the average traffic of the London subscriber.

Mr. Sterne's attempt to contradict General Tracy, as regards the London rate, is no more fortunate than his showing of the large number of subscribers in London. In the pamphlet edition of his speech occurs the following: "The number of exchanges in London is considerably more than in New York, so that you can readily imagine the volume of business done by that concern and how little likelihood there is of any person being farther away than a mile from any central station; so that the element of £2 10*s.* additional distance charge, which played so important a role in General Tracy's argument, operates merely in the outlying districts of the city, which are, in substance, rural districts and not metropolitan districts. There are but comparatively few subscribers more than one mile distant from an exchange." In his speech, Mr. Sterne said London had 600 exchanges. Mr. Milburn told him there are but 32. Mr. Sterne declines to use figures, but says that the number of exchanges is considerably more than in New York. Which is true, but an "exchange" may contain anywhere from five to 5,000 subscribers, and the number of subscribers in New York is 50 per cent more than in London in spite of difference in rate, area and population. Then, how can one "readily imagine," from the greater number of exchanges, the volume of business done or the likelihood of any person being farther away than a mile from any central station? Nobody but one gifted with the peculiar powers of imagination of a Sterne could readily imagine anything of the sort. In point of fact a large number of exchanges tends to check business by making connections more difficult to obtain. Regarding the other point, a very slight calculation would have shown Mr. Sterne that a great many persons in London must be more than a mile from an exchange. There are 32 exchanges and each one serves an area of 3.14 square miles, within which a subscriber must be to escape the extra mileage charge. This gives a total area of 100 square miles in which people are within a mile of an exchange and an area of 630 square miles in which people are more than a mile distant from an exchange.

Mr. Sterne, with all the hardihood that complete ignorance of the subject in hand gives a man who is merely making an "argument," repeats his assertion that unlimited service over the London-Paris line is accorded to London subscribers for a flat rate of $200 a year. He adds, "at a pay station I telephone (to Paris from London) for $2.50, half the price for a like distance of service in the United States." There are two more misstatements in this sentence. The rate from Paris to London is 8*s.*, or $2, for three minutes. The distance is 310 miles. The rate for five minutes' conversation between New York and Boston or New York and Washington is $2. The distance is about 20 per cent less, but the time of conversation allowed is 60 per cent more, so the rate is really cheaper here. Mr. Sterne is in rather an awkward situation, on the horns of a dilemma, as it were. He can only make "arguments" by dint of garbling figures, distorting facts and drawing deductions from ignorant assumptions, and his opponents can refute his statements at every point. On the other hand, were he really to study the telephone business and provide himself with correct information, he would have no fuel for arguments in favor of telephone bills and would have to cease posing as a reformer.

Electricity in the Shoe Shop.

An interesting electric power transmission plant is in process of installation by the General Electric Company at Rochester, N. H., for the operation of Messrs. E. G. & E. Wallace's shoe factories.

The system adopted is the three-phase system devised by the General Electric Company. It is on this system that many important power-transmission plants in this country are now being operated, as in installation and operation it has been found very economical.

The source of power is steam, the fuel being the scrap bark—the refuse from the tanneries located on the ground. The generator will be a 140-kilowatt or about 190 horse-power machine wound for 560 volts, as the distance of transmission is insignificant. The motors will be of the induction type, without commutators or moving wires, and will be operated without the use of transformers. These motors will be 500-volt machines, of five horse-power, 15 horse-power, 20 horse-power and 25 horse-power capacities. Another generator, to be used principally for lighting, will shortly be added.

The installation of this plant was determined upon after a careful examination of the merits of the three-phase system, and the economy likely to be induced by its adoption, when compared to the cost of installation and maintenance of a system of mechanical distribution of power, *i. e.*, by belts, line shafting, etc. Messrs. E. G. & E. Wallace had already experimented with motors in the operation of their shoe factory, and the great economical and other benefits which accrued proved the deciding factor, which resulted in the present installation.

The Jules Viennot Agency.

[*From Profitable Advertising.*]

In the special field of advertising the growing success of the Jules Viennot Agency, of Philadelphia, for manufacturers is interesting, as it throws light on the importance of the industrial press of America. Manufacturers realize the need of advertising in their respective line of papers, but how to do it, where to do it, when to do it, are questions which the average mind, wrapped in entirely different lines of thought, does not care to grapple. For this work Mr. Jules Viennot acts in the capacity of a confidential adviser in the preparation and placing of advertising to 45 or more large manufacturers like the Brill Car Company, Merchant & Company, the Baldwin Locomotive Works, Standard Steel Works, Trenton Iron Works, Morris, Morris, Tasker & Company, and other concerns of a like nature which use only class publications.

TESTS OF THE GÜLCHER THERMO-ELECTRIC BATTERY.

TRANSLATED FROM THE "ELECTRO-TECHNISCHE ZEITSCHRIFT" AND "L'ECLAIRAGE ELECTRIQUE."

The following tests were made on four cells, each of 66 elements. Two amongst these cells, Nos. 263 and 228, had been in use for 200 hours; a third, No. 333, had been in use for a still longer time; while the fourth had been employed for charging accumulators for about two years.

In the experiments about to be described, use was made of the cells Nos. 263 and 228 connected in series. Determinations were made of the

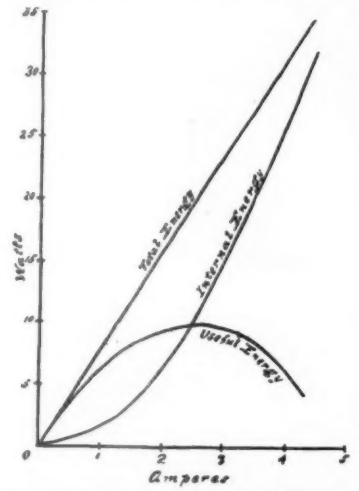

FIG. 1.—ENERGY CURVES OF A THERMO-ELECTRIC CELL FOR DIFFERENT DISCHARGE RATES.

total energy, the energy dissipated in the external circuit and that dissipated in the battery. A knowledge of these quantities enables us to determine the internal resistance of the battery by the following method:

$$E = E_o + i_o r.$$
$$I = I_a + I_g.$$
$$Ir = E - E_g = E_o + I_o r - E_g.$$
$$r = \frac{E_o - E_g}{I - i_o} = \frac{E_o - E_g}{I_a + i_g - i_o}.$$

In which, E is the electro-motive force of the battery; E_o is the difference of potential with the main circuit open; i_o is the current indicated by the galvanometer while measuring E_o; E_g is the difference of potential when the main circuit is closed; i_g is the current through the galvanometer while measuring E_g; I_a is the current in the principal circuit; and I is the total current furnished by the cell.

The results of the measurement of electrical energy are given in the form of curves in Fig. 1. In these measurements the pressure of the gas from the beginning was maintained constant at 30 millimeters of water (about 1.18 inches or 0.0427 pounds per square inch). The resistance of the two cells in series was found to be 1.56 ohms.

The maximum useful output was obtained, as is seen from Fig. 1, when the electrical energy lost in the cell is equal to that expanded in the external circuit. The point of intersection of the two curves corresponds to a current of 2.51 amperes and a useful output of 9.9 watts. The corresponding difference at the terminals is given in Fig. 2, in which the two curves indicate respectively the difference of potential at the terminals and the fall of potential in the battery at different rates of discharge. The point of intersection of the latter curves, which also correspond to the maximum useful output, has for an ordinate 3.92 volts.

Other measurements had for their object the study of the relation between the electro-motive force of the cell and the pressure of the gas. As a certain length of time is required to re-establish a steady difference of temperature between the parts of the cells, after a change in the pressure of the gas has been made, the pressure should have been maintained constant for at least 15 minutes after each such change; but as this condition was difficult to realize, three sets of measurements were made, the mean of the results of which is given of the dotted curve Fig. 3. This curve coincides for pressures greater than 11 millimeters (.0156 pounds per square inch), with the parabola, whose equation may be written

$$E = \sqrt{2.098\ p}$$

where p is the pressure of the gas. This parabola is given by the smooth curve Fig. 3.

Since the volume of gas delivered is proportional to the square root of the pressure it is fair to assume that the electro-motive force of the cell is directly proportional to the consumption of gas, at least between the pressures 11 and 34 millimeters of water. This feature of the cell can be made use of under certain circumstances. When, for example, for some reason it is desired to diminish the output or the rate of discharge of the latter, instead of introducing resistance in the circuit, which dissipates energy uselessly, the pressure of the gas may be lowered with the desired result. By another series of measurements the counter or back electro-motive force, due to the flow of heat from the hot to the cold

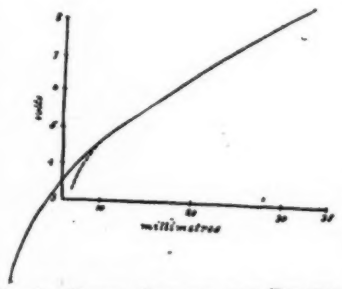

FIG. 3.—CURVE SHOWING THE RELATION BETWEEN THE ELECTRO-MOTIVE FORCE OF THE THERMO-ELECTRIC BATTERY AND THE PRESSURE OF THE GAS.

junctures of the cell,* was determined. This loss of electro-motive force, as will be seen from the curve in Fig. 4, only reaches 0.227 volt for a discharge rate of four amperes, and, therefore, cannot sensibly effect the constancy of the electro-motive force of the cell for a given pressure of gas.

The rise of electro-motive force in the cell, after lighting the gas flames, is given by the upper of the two curves in Fig. 5, which has for abscissæ times and for ordinates electro-motive force. In the same way the lower of these curves shows the manner in which the electro-motive force of the cell drops after the gas flames are extinguished.

These latter experiments show that to obtain the normal voltage it is necessary to wait at least 24 minutes.

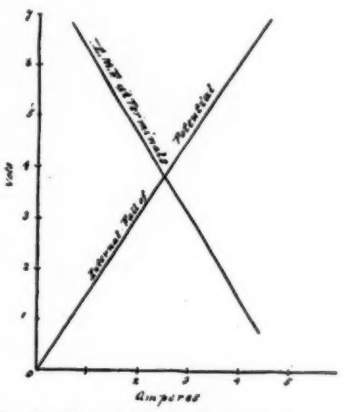

FIG. 2.—ELECTRO-MOTIVE FORCE CURVES OF A THERMO-ELECTRIC CELL FOR DIFFERENT DISCHARGE RATES.

In the table below are given the resistances in ohms when hot and cold of the four Gülcher cells experimented with:

No.	Hot.	Cold.
263	0.775	0.626
228	0.786	0.637
306	0.912	0.745
333	0.808	0.642

The cell No. 306 had been in continuous use for nearly two years. Since all these cells had been handled in accordance with the instructions

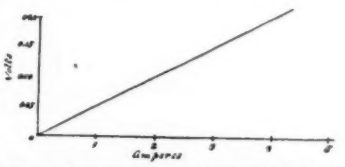

FIG. 4.—CURVE OF THE COUNTER ELECTRO-MOTIVE FORCE, DUE TO THE COOLING OF THE HOT ELECTRODE AND THE HEATING OF THE COLD ELECTRODE.

furnished by the manufacturer, it is fair to suppose that while in use the internal resistance of these cells at first rises fairly rapidly and then more slowly. The resistance of these cells when new was 0.59 ohms.

The cells Nos. 263 and 228 had only been in use about 200 hours and the cell No. 333 at most about 500 hours.

The measurement of the consumption of gas at the pressure of 30 millimeters of water gave for cell No. 263 an expenditure of 164 liters an hour (about 5.79 cubic feet), the electro-motive force produced being 3.97 volts. J. S. S.

On account of the damage resulting to public documents by the use of gas in the office vaults of the court house at Tiffin, Ohio, the County Commissioners have decided to discard the use of gas for the court house entirely, and have directed that a contract be entered into with the Tiffin Edison Electric Light and Illuminating Company for electric lights.

The Consolidated Electric Storage Company, of New York city, has declared a dividend of one per cent to stockholders of record and to holders of receipts and certificates of the General Electric Company payable April 10. Books closed March 30.

AMERICAN BELL TELEPHONE COMPANY'S ANNUAL REPORT.

THE DIRECTORS' FIFTEENTH ANNUAL STATEMENT—FULL TEXT OF THE REPORT OF THE BUSINESS FOR THE YEAR ENDING DECEMBER 31, 1894.

The annual meeting of the stockholders of the American Bell Telephone Company was held at the company's offices in Boston on Tuesday, March 26. The fifteenth annual report of the directors for the year ending December 31, 1894, as presented by President John E. Hudson, is given below in full:

The output of telephones from 1884 to the close of the year 1894, and the consolidated statistics of our company's licensees are as follows:

INSTRUMENTS IN THE HANDS OF LICENSEES UNDER RENTAL.

(The figures in last column show increase from year to year.)

December 20,	1884	325,574	.....
" "	1885	330,040	4,466
" "	1886	353,518	23,478
" "	1887	380,277	26,759
" "	1888	411,511	31,234
" "	1889	444,861	33,350
" "	1890	483,790	38,929
" "	1891	512,407	28,617
" "	1892	553,720	40,318
" "	1893	566,491	13,771
" "	1894	582,506	16,015

The increase, within the year, of the aggregate number of subscribers reported by the various companies was somewhat larger than that of the previous year, and taking into consideration the facts that general business throughout the country had not recovered its usual activity, and that the growth of the telephone business must be in great measure dependent upon the prosperity of commercial and manufacturing interests, the results have been on the whole satisfactory.

In comparing the gain in the output of telephones for the year 1894 over that of the year 1893, 16,015 telephones for 1894, as against 13,771 in 1893, attention should be called to the fact that in the months of January and February the returns exceeded the output by 3,472, so that the actual growth in number of telephones during the remaining 10 months would be little short of 20,000 instruments.

Extensive additions and improvements of plant have been made by most of the companies, especially in the direction of underground and toll line construction.

A greater mileage of toll wires has been added than in any previous year in the history of the business.

Not including the cost of current repairs and renewals, the companies operating under our licenses have expended during 1894, upon extensions of lines and apparatus, $4,138,000, and for buildings to accommodate their exchanges $411,000, making, with the amount reported last year, a total of investment in telephone property in the United States of $77,500,000.

The pole line construction of the Long Distance Company last year consisted mainly

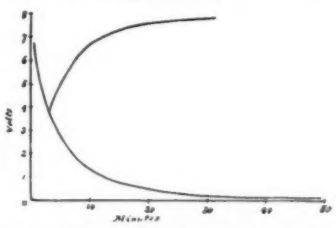

FIG. 5.—CURVES SHOWING THE VARIATION OF THE ELECTRO-MOTIVE FORCE OF THE THERMO-ELECTRIC BATTERY IMMEDIATELY AFTER THE LIGHTING OR EXTINCTION OF THE GAS FLAMES.

of the line from Pittsburgh to Chicago *via* Indianapolis, and the line between Erie, Pa., and Norwalk, Ohio. No very important new places were reached during the year. The principal points to which service was opened were Richmond, Waterloo, Terre Haute and Michigan City, Ind.; Piqua, Tadmore, Columbus, Springfield, Zanesville, Cambridge and Chillicothe, Ohio; Wheeling, W. Va.; Danville, Ill.; and McKeesport and Northumberland, Pa.

The construction department reports that the total of lines, December 31, 1894, was 4,617.24 miles of pole line and cables and 75,555.72 miles of wire. Of this there were constructed during the year 633.26 miles of pole line and 9,379.71 miles of wire.

The metallic circuit system has grown

* This refers to the Peltier effect, which tends to cool the heated juncture and heat the cooled juncture in a thermo-pile when the cell is permitted to develop a current.

rapidly in favor and at the close of the year the stations of 54,680 exchange subscribers were furnished with the equipment for this improved class of service, a gain during the year of 17,032.

The steadily increasing use which subscribers make of the exchange service continues to be a noticeable feature of the statistics furnished us by the operating companies.

On the average each subscriber throughout the country now uses his telephone upon calls made and received 17 times per day.

While this enlarged use is gratifying as an indication of the enhanced value which the subscriber derives from the service, the greater demand thus made upon the exchange system of necessity involves a corresponding increase in the cost of rendering service and a larger investment per station for central office apparatus and trunk lines.

Comparing the latest statistics with those of six years ago, we find the total number of subscribers has increased by 42 per cent.

Within the same time the average daily use of the exchange service by each subscriber has increased 40 per cent, and the number of employés engaged upon exchange work 76 per cent.

The great disparity in the number of calls made by different subscribers in the same exchange, who, though paying the uniform yearly rate, require in the transaction of their business a widely varying amount of daily service, has led several of the companies, especially in the large cities, to consider the adoption of a plan for measured service, of which advantage can be taken by the smaller users.

This question was discussed in the last annual report, and it was there stated that "some experiments are in hand to see if in the great cities the case of those who want only a limited use of the telephone at a less rate than is fixed for an unlimited use can be met."

The plan has already been put in operation in New York, Brooklyn, Boston and some other exchanges. The choice is offered to subscribers of paying either the fixed yearly rate, with unlimited local service, or a graduated scale of charges, dependent upon the extent of use within the year, the cost per connection lessening with the increase in the number of calls for which contract is made.

This system is an alternative to that of unlimited use, is equitable to those whose requirements for service are not large and has commended itself to a considerable number of the telephone users in the exchanges named, some thousands being now connected on the measured service plan.

The application to the legislature for authority to increase the capital to $50,000,000, of which mention was made in the last report, resulted in Chapter 544 of the Acts of the year 1894, authorizing the increase, but providing that in the first instance the stock should be offered to the stockholders at the market price, to be determined by the Commissioner of Corporations, having in view actual sales and "other pertinent conditions," and that what should remain undisposed of in that mode should be offered for sale by public auction.

As you will remember, at a special meeting of the stockholders, held November 15, 1894, it was voted that the Act be accepted and the stock be increased by 5,000 shares, say, at par, $500,000. Upon application to the Commissioner of Corporations, he fixed the price at which this should be offered to the stockholders at $190 per share, and it was so offered. Sixteen hundred and thirty-two shares were taken by stockholders; the remainder, 3,368 shares, were sold on the 9th day of February, 1892, by public auction at an average price of $189.75 per share.

The suit of the United States *vs.* the American Bell Telephone Company and Alexander Graham Bell still remains pending, notwithstanding that the two Bell patents, No. 174,465, of March 7, 1876, and No. 186,787, of January 30, 1877, which it was brought to annul, have both expired.

The deposition of Mr. Franklin L. Pope was concluded May 15, 1894, and on June 15, 1894, the court extended until January 1, 1895, the time within which the defendants might take further evidence.

Owing to unavoidable interferences and to the illness of counsel for complainant, the time for taking defendants' evidence has again been extended to June 12, 1895. By that date, if no accident prevents, the defendants expect to have closed their testimony.

The suit of the United States *vs.* the American Bell Telephone Company *et al.*—the Berliner suit, so-called—was argued June 14-20, 1894, before the Circuit Court. The court, on the 18th day of December, 1894, rendered a decision that the patent was void. An appeal has been taken to the Circuit Court of Appeals, and the cause is expected to be argued next month.

In the Western Union Telegraph Company *vs.* the American Bell Telephone Company it will be remembered that a decree was made by the Circuit Court allowing the motion of the plaintiffs to dismiss their case without prejudice. This motion was made upon the coming in of a report of the Master finding that the plaintiffs were not entitled to the account asked for. An appeal was taken, and the decree of the Circuit Court has been reversed by the Court of Appeals, the case being remanded to the Circuit Court for further proceedings.

In the thirteenth annual report it was stated that Edison's application for a patent for the carbon telephone had resulted in patent No 474,231; but it was said:

"It is necessary to add, however, that Edison's foreign patents for the same invention, although applied for subsequently to the application in this country, had expired previously to the grant of the American patent. Our counsel inform us that the law is unsettled, whether in such cases the American application should be defeated by the expiration of the foreign patent, but that the better opinion is that the expiration of the foreign patent is immaterial."

The question involved has recently been determined by the Supreme Court in the case of Bate Refrigerator Company *vs.* Ferdinand Sulzberger *et al.*, which holds in substance that the domestic patent in such case is determined by the expiration of the foreign patent, notwithstanding that the domestic application is earlier than the application for the foreign patent. The result of the decision is to annul the Edison patent.

The ledger balances as they stood on the 31st of December, 1894, and a statement in detail of the earnings and expenses of that year, and of the earnings and expenses of the year 1893, for purposes of comparison, are furnished by the treasurer and are appended.

The Long Distance Company had invested up to December 31, 1894, in line construction, equipment and supplies, $7,460,662.97. The company shows an increase in gross earnings in 1894 over 1893 of 13.4 per cent, the amount for 1894, gross, being $1,011,961.82. It will be remembered that the gross earnings for 1892 were $643,436.77; for 1893, $892,361.62.

Copies of the reports of the Auditing Committee of April 13, 1894, July 14, 1894, October 18, 1894, and January 14, 1895, accompany this report. For the Directors,

JOHN E. HUDSON,
President.

Surplus Account, December 31, 1893	$2,151,011.61	
Net Earnings, 1894	3,123,785.07	
		$5,274,796.68
Regular Dividends, 1894	$2,400,000.00	
Extra Dividends, 1894	600,000.00	
Reserve for Depreciation of Instruments	123,785.07	
		3,123,785.07
Surplus Account, December 31, 1894		$2,151,011.61

About 100 stockholders were present at the meeting, which was called to order by President J. E. Hudson at 11 o'clock, and in 20 minutes all business had been transacted. The number of directors was increased from 12 to 13. Two new men were elected to the board. They were Charles W. Amory, who succeeds Thomas P. Bailey, resigned, and Moses Williams. William R. Driver was re-elected treasurer and Charles Eustis Hubbard clerk. The list of directors, as it now stands, reads: Charles W. Amory, Francis Blake, Charles P. Bowditch, George L. Bradley, Alexander Cochrane, W. H. Forbes, H. S. Howe, C. E. Hubbard, John E. Hudson, Charles E. Perkins, Thomas Sanders and Moses Williams.

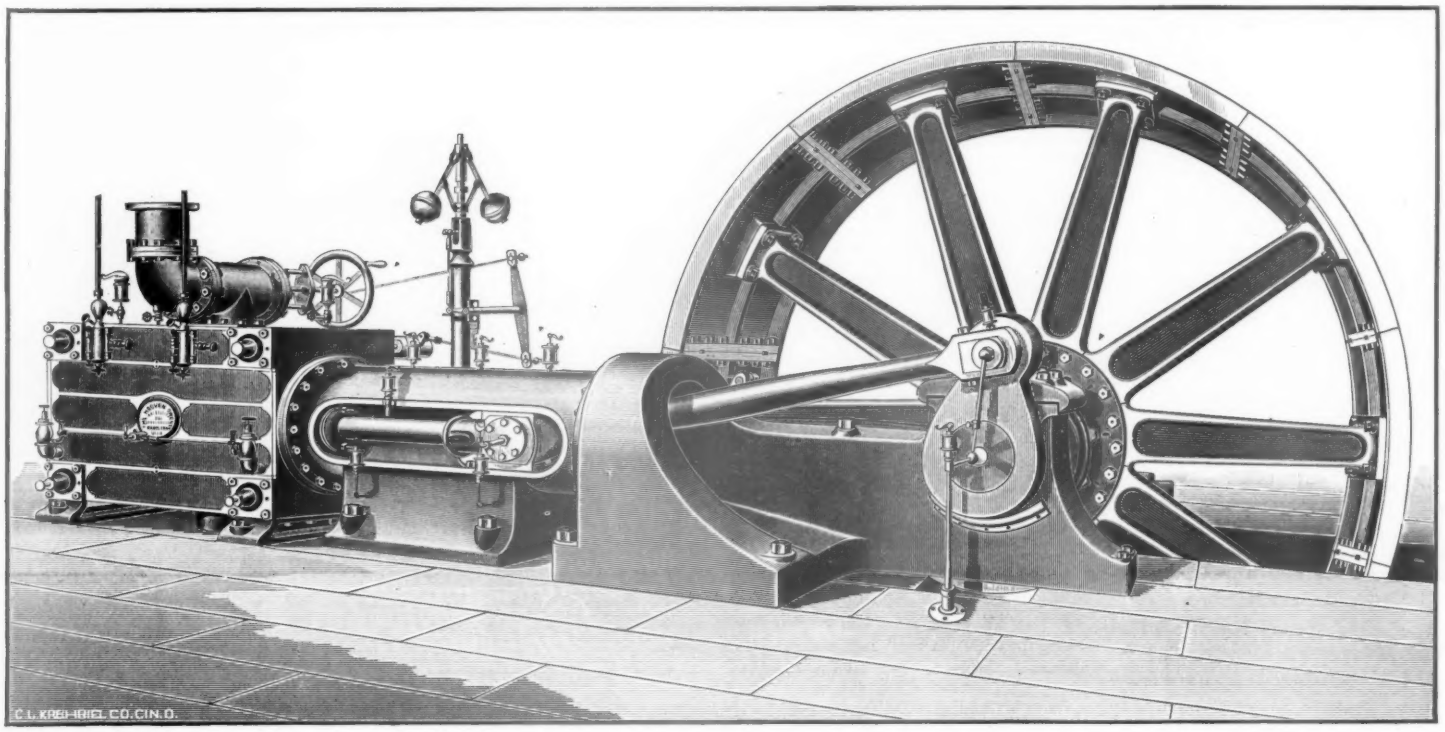

FIG. 1.—THE HOOVEN, OWENS & RENTSCHLER COMPANY'S HAMILTON-CORLISS ENGINE.

LEDGER BALANCES, DECEMBER 31, 1894.

DEBTORS.

Telephones	$ 1,209,787.77
Real Estate	950,926.86
Stocks	38,268,455.95
Merchandise and Machinery	14,232.70
Bills and Accounts Receivable	4,855,554 55
Cash and Deposits	760,776.08
	$45,559,733.91

CREDITORS.

Capital Stock	$20,000,000.00
Debenture Bonds, 1888	2,000,000.00
Bills and Accounts Payable*	1,107,949.92
Patent Account (Profit and Loss)	10,228,571.33
Profit and Loss	5,849,444.13
Reserve	4,222,756 92
Surplus	2,151,011.61
	$45,559,733.91

COMPARATIVE STATEMENT OF EARNINGS AND EXPENSES.

EARNINGS.

	1893.	1894.
Rental of Telephones	$3,513,7 1.42	$3,502,992.17
Dividends	†1,824,431.98	*1,937,657.77
Commission from Extra Territory Lines	108,621.38	106,939.46
Commission from Telegraph Business	29,192.79	29,352.96
Real Estate	68,097.06	69,675.09
Interest	225,936.28	196,455.11
Miscellaneous	11,086.08	5,172.38
	$5,781,076.99	$4,848,244.94

EXPENSES.

Expenses of Operation	$ 392,770.39	$ 430,340.29
Legal Expenses	114,852.47	178,342.88
Real Estate	44,532.41	35,798.34
Interest and Taxes	300,368.38	356,478.51
Commission	690,380.58	459,958.71
Royalty	10,000.00	5,000.00
Concessions	257,829.92	231,713.64
Miscellaneous	44,857.15	26,827.50
	$1,855,591.30	$1,734,459.87
Net Earnings	$3,925,485.69	$3,123,785.07

*Of this amount $900,000 is for the dividends payable January 15, 1895, to stockholders of record December 31, 1894.

† No portion of the earnings of the Metropolitan Telephone and Telegraph Company was divided.

LITERARY.

We have received "The Telegraphist's Guide to the New Examinations in Technical Telegraphy," by James Bell, American Institute of Electrical Engineers, price, one shilling and six pence. — *Electricity*, London.

Scribner's Magazine for April abounds in Easter features. The cover itself is a very striking arrangement of lilies. The frontispiece is a particularly excellent engraving by Closson of a painting called "The Worshipers." Then follow a striking series of Easter pictures by four of the best illustrators of our day—Smedley, Lynch, Abbey and Weeks. These illustrations represent Easter scenes in New York, Paris, old England and Jerusalem. Another original feature of the number is an Easter hymn (written many years ago by Thomas Blackburn), interpreted in a series of six full pages by Henry McCarter.

New York Electrical Society.

Prof. M. I. Pupin, of Columbia College, delivered before the New York Electrical Society, on March 25, a lecture on "Tendencies of Modern Electrical Research."

The Hooven, Owens & Rentschler Company's Hamilton-Corliss Engine.

Every user of steam power knows the principles on which the Corliss engine is constructed. In the use of these principles all builders of Corliss engines unite. It is only in matters of detail that they differ.

These differences are in such points as general design to better fit the engine for use in a given locality, or, under special circumstances; in the character of materials used and in workmanship and in proper proportioning of the parts for strength and adaptability to given uses. These are by no means slight or unimportant matters, and an engine constructed on the most scientific principles may utterly fail if the workmanship is poor, if the materials are inferior, or if the parts of the engine that must bear the severest strain are not strong enough to meet these strains. The securing of these details is of the utmost importance. The engine illustrated herewith is of the Hamilton-Corliss type and has been especially designed for electric railways, electric light and for rolling mill work.

It is a good illustration of one recently installed at the Edison Illuminating Company of St. Louis' Station, St. Louis, Mo.; Cincinnati Street Railway Company; city of Jacksonville, Fla.; city of Hamilton, Ohio, and others. The makers have now in construction three cross-compound-condensing engines for the St. Charles Street Railway Company, New Orleans.

Special attention is called to the massive construction of the bed plate and to the general design, which is especially adapted to meet the universal demand of all classes of heavy work and the variable load experienced in using this class of machinery. In its workmanship and in the materials used it leaves nothing to be desired.

This engine is also in use in natural gas pumping plants with great success. The Hamilton-Corliss engine is built by The Hooven, Owens & Rentschler Company, Hamilton, Ohio, which is one of the oldest makers of steam engines in the country. The branch offices of this company are located at 39–41 Cortlandt street, New York; J. A. Grant & Company, 8 Oliver street, Boston, Mass.; 46 South Canal street, Chicago; Room A, Laclede Building, St. Louis, Mo., and C. C. Moore & Company, San Francisco, Cal.

President Pierce Killed by an Electric Shock.

A sad accident, but one due entirely to rashness, resulted in the death of Mr. William S. Pierce, of Petaluma, Cal., on March 21. Mr. Pierce was manager and chief owner of the Petaluma Electric Light and Power Company, president of the Pierce Telephone Company, president of the California Dairymen's Union, and one of the wealthiest residents of Petaluma. He had been ordered to take active exercise for his health, and seeing a broken wire, ascended a pole, heedless of his assistant's warning. On reaching the first crosspiece, about 40 feet from the ground, he ran his right hand over several wires, when suddenly he touched one from which the insulation had been worn. He dropped backward across the arm and hung there until a hook and ladder company took the body down. It is reported that a current of 5,000 volts passed through Mr. Pierce's body. Several doctors worked over the body an hour, but resuscitation was impossible.

The Government Post Office authorities are preparing plans for a considerable extension of the street railway mail service.

TELEPHONE NEWS AND COMMENT.

On March 27, the Metropolitan Telephone and Telegraph Company, of New York city, adopted a new schedule of rates for local messages over direct lines. For payment in advance of full price of contract an additional credit in messages equal to 10 per cent of the number paid for will be allowed. Subscribers under other rates, to whom the new schedule offers advantages, are at liberty to cancel their actual contracts and to take new ones under the new schedule. The new rates are given below in full:

Messages.	Rate subject to rebate for unused messages	Rate not subject to rebate for unused messages.	Extra messages each.
1,000	120	...	8 cts.
1,100	126	...	8
1,200	132	...	8
1,300	138	...	8
1,400	144	...	7
1,500	150	145	7
1,600	155	...	7
1,700	160	...	7
1,800	165	...	7
1,900	170	...	7
2,000	175	165	7
2,100	180	...	7
2,200	185	...	7
2,300	190	...	7
2,400	195	...	7
2,500	200	180	7
2,600	205	...	7
2,700	210	...	7
2,800	215	...	7
2,900	220	...	7
3,000	225	195	7
3,100	230	...	7
3,200	235	...	7
3,300	240	...	7
3,400	245	...	7
3,500	250	210	7
3,600	255	...	7
3,700	260	...	7
3,800	265	...	7
3,900	270	...	7
4,000	275	225	7

The Nebraska Telephone Company will reduce rates in Omaha about 20 per cent.

The Central Union Telephone Company is reducing rates all over the State of Ohio.

The Bell people are reported to have offered free service in Dubuque, Ia., if an opposition company is started there.

The Western Electric Company has secured a final decree against the Mianus Electric Company *et al.*, of Mianus, Conn., for infringement of the Roosevelt patent, No. 215,837, for a switch-hook.

Mr. C. F. Barnes has resigned as manager of the Central Union Company's exchange at Columbus, O., to go into business for himself in the same city. He is succeeded by Wm. O'Gara, of Lancaster, O.

The citizens of Carbondale, Pa., are about to organize a company for the establishment of a telephone exchange. Parties who are prepared to furnish a complete and reliable system can obtain further information upon application to A. P. Trautwein, secretary of the Board of Trade.

The Central Union Telephone Company are rebuilding their plant in the city of Dayton, O., under plans and specifications which, it is claimed, will make it the model plant of the country. The distribution of cables is said to be exceptionally fine. All outside wire is No. 14 hard drawn copper and the inside of all buildings is wired with the best quality of duplex. The central office is also being remodeled in a thoroughly modern way and every possible attention is to be given to all details throughout the plant. General Foreman Cline is giving personal attention to this work.

The Elkhart, Ind., Telephone Company has been organized under the laws of Indiana. The board of directors comprise R. E. Campbell, general manager of the Baltimore and Ohio Railroad Company, Baltimore; H. E. Bucklen, president of the Elkhart and Western Railroad Company, Chicago; Charles Selden, superintendent of telegraph Baltimore and Ohio Railway, Baltimore; O. N. Lumert, Elkhart, Ind.; Joseph Claybaugh, Indianapolis; W. F. Banfiel, Frankfort, Ind. The company claims to have unlimited capital at its command.

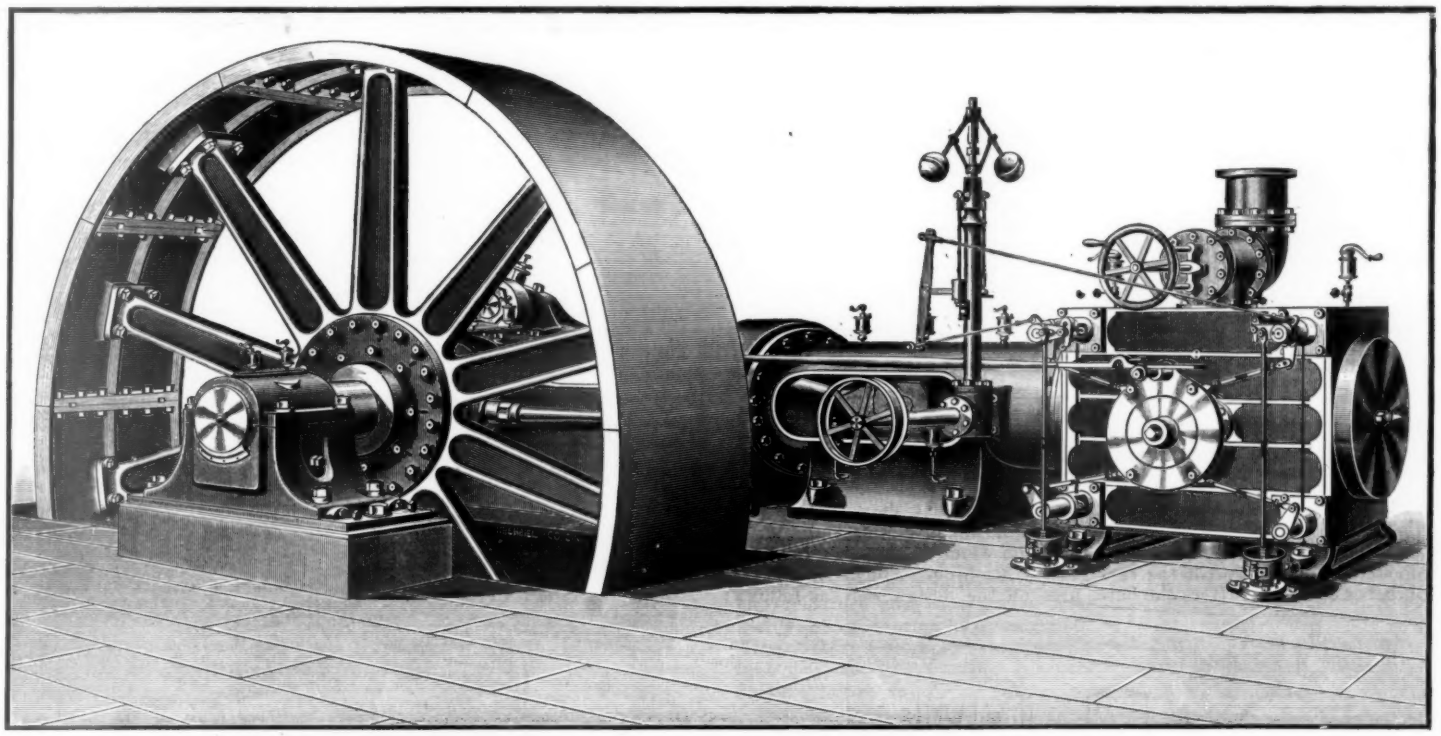

FIG. 2.—THE HOOVEN, OWENS & RENTSCHLER COMPANY'S HAMILTON-CORLISS ENGINE.

A METHOD FOR PREVENTING ARMATURE REACTION.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK AND CHICAGO, MARCH 20, 1895, BY HARRIS J. RYAN AND MILTON E. THOMPSON.

(Continued from page 159.)

Figs. 11, 12, 13 and 14 give interesting results that were obtained by lowering the field electro-motive force and

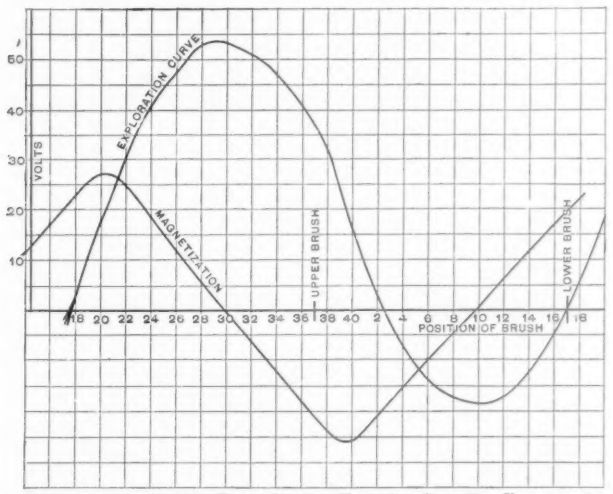

FIG. 11.—EXPLORATION CURVE, FULL LOAD. V = 36. C = 20. EXCITING CURRENT, 2.5 A. SPEED, 1,800 REVOLUTIONS PER MINUTE. OPERATED AS A DYNAMO WITHOUT BALANCING COIL.

then operating as before. By operating as a dynamo or motor without the coil, extraordinary powerful armature reactive effects are produced. It is seen that the brushes are in the presence of a reversed field that is quite as great as the normal no load field of 3,000 lines per square centimetre, and moderate sparking with the carbon brushes occurred. Here the balancing coils bring out an interesting effect. One would expect that the effects of their over-balancing action would be felt more at lower excitations. In this experiment the induction at the advance pole tip or the position of the "commutation fringe" is almost doubled from the normal no load value instead of being diminished as is ordinarily the case. It is appreciated that the effect of such a behavior is to increase the strength of the commutating fringe at the leading pole tip in proportion to the load, thereby diminishing the range of change of the non-sparking point with metallic brushes, or enabling carbon brushes to be easily adjusted so that when in a fixed position there will be practically no sparking at all ranges of load.

The second machine that was built, and which made use of balancing coils, was a small one of the four-pole type with cast-iron field magnets. This machine was designed to have a capacity of 25 amperes at 80 volts, or 2 kilowatts when running at a speed of 1,200 revolutions. Fig. 15

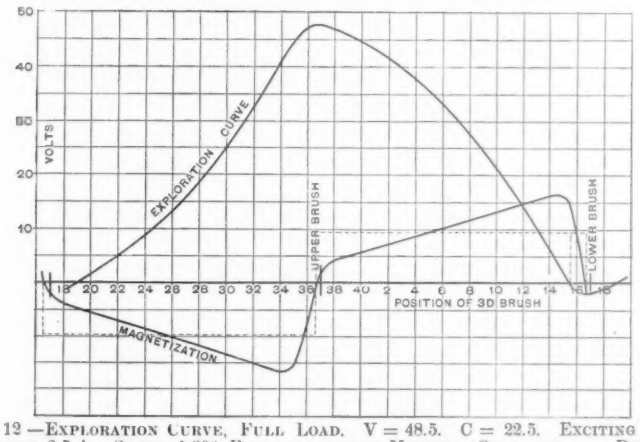

FIG. 12.—EXPLORATION CURVE, FULL LOAD. V = 48.5. C = 22.5. EXCITING CURRENT, 2.5 A. SPEED, 1,800 REVOLUTIONS PER MINUTE. OPERATED AS A DYNAMO WITH BALANCING COIL.

is a diagram that shows the general design of the machine, and Fig. 16 is made from a photograph of the actual machine. The essential features of the design were as follows:

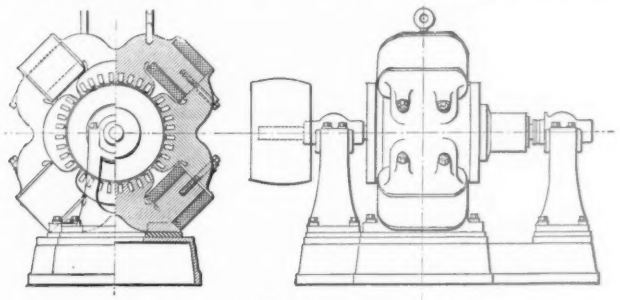

FIG. 15.

Type of machine, 4 pole; field, cast-iron in two pieces. Armature, two-circuit drum winding through 58 grooves; five No. 10 B. & S. G. wires in each groove; 29 commutator bars; grooves milled out, size five-eighths by nine-sixty-fourths inch; outside diameter of core, seven and one-half inches; inside, three inches; surface of completed armature wound with No. 14 B. & S. G. iron wire. Length of armature and poles, six inches each. Effective length of iron in armature core, five inches; magnetic leakage, 15 per cent. Field cores, five by two inches, with rounded ends; area, nine-fourteenths square inches. Mean length of field magnetic circuit, 12.5 inches. Magnetic density in armature core, 5,400 gausses; in air-gap, 4,900; in the armature teeth, 8,400; in the field cores, 6,800. Field winding, mean length of turn, 15 inches, requisite exciting M. M. F. for field circuit, 1,145 gilberts; for armature, 31.3 gilberts; for air-gap, 1,258 gilberts; or a total of 2,434 gilberts; size of field wire, No. 18 B. & S. G. Number of holes for balancing coils, five in each pole-piece, even conductors per pole or 140 conductors total. Weight of complete machine, 400 pounds.

An examination of this data discloses the fact that no regard is had for the pernicious effects that are ordinarily met with in the use of so short an air-gap with a comparatively large number of armature ampere turns. With the use of the balancing coils no such effects were observed; the machine performed precisely in accordance with the original estimate made in designing it, and exactly as theory shows that ordinary machines would perform if armature reaction were entirely absent.

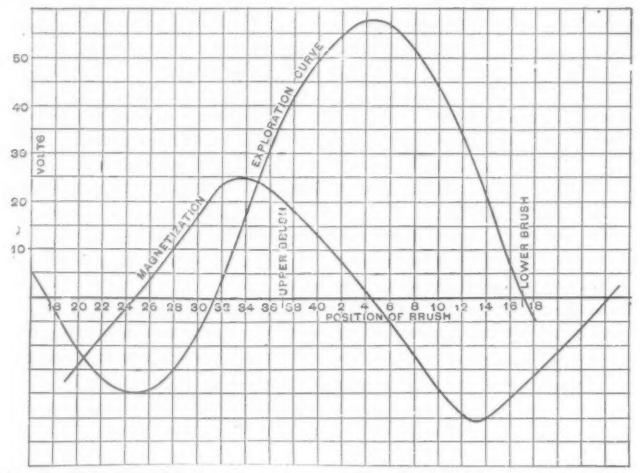

FIG. 13.—EXPLORATION CURVE, FULL LOAD. V = 36.5. C = 23.5. EXCITING CURRENT, 1.6 A. SPEED, 1,600 REVOLUTIONS PER MINUTE. OPERATED AS A MOTOR WITHOUT BALANCING COIL.

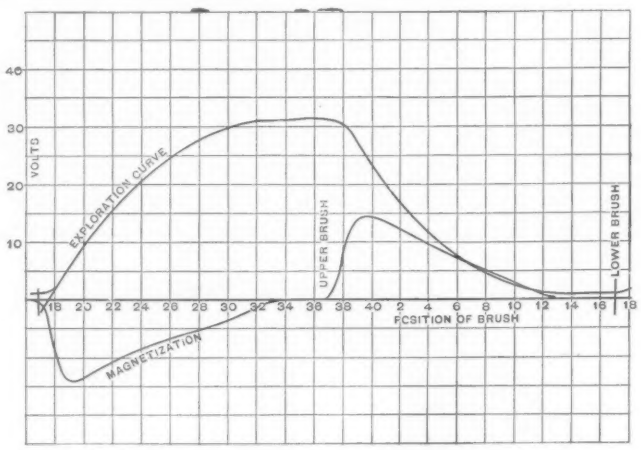

FIG. 14.—EXPLORATION CURVE, FULL LOAD. V = 31. C = 24. EXCITING CURRENT, 1.6 A. SPEED, 1,520 REVOLUTIONS PER MINUTE. OPERATED AS A MOTOR WITH BALANCING COIL.

During test the machine was belted directly to a 10 horse-power Sprague motor, and ran at a speed varying from 1,500 to 1,650 revolutions per minute. The commutator was quite small for a four-pole machine; it had only 29 segments and was very poorly suited for the pressure of 100 volts at which it was tested. The machine was loaded down to 43 amperes at 100

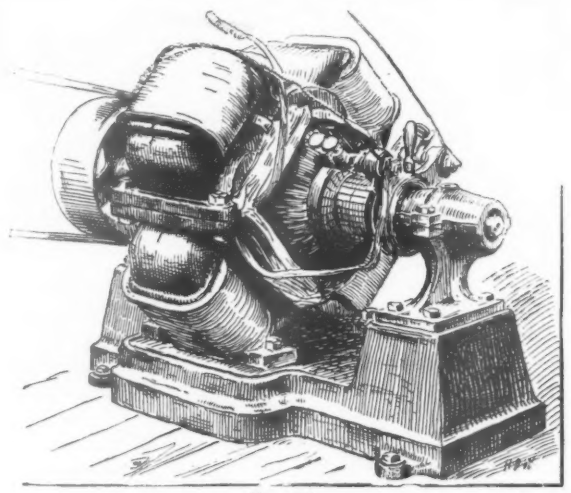

FIG. 16.

volts, speed 1,650, and an exploration curve taken around the commutator. This curve is shown in Fig. 17 and clearly indicates the entire absence of

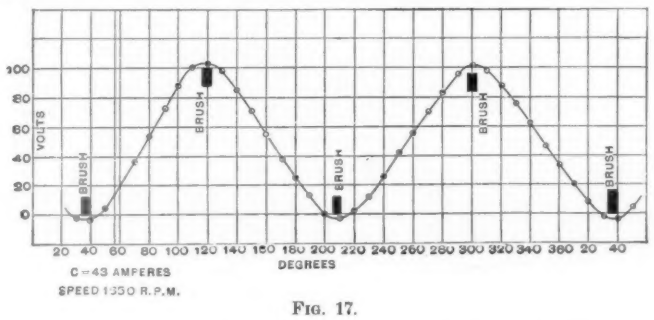

FIG. 17.

field distortion. It was found that the machine would easily carry a load of 45 amperes continuously without overheating. After this curve was taken the machine was loaded down as heavily as the driving belt would permit, and ran at a load of 80 amperes and 80 volts for about 15 minutes. Under this load there was no appreciable difference from light load in the behavior of the commutator. The balancing coils were short-circuited for an instant while the machine was loaded to 40 amperes, and the vicious sparking that ensued showed that the dynamo could not be operated at this load without the balancing coils. Indeed, the indications were that it would have been fatal to the welfare of the commutator, and perhaps to the armature itself, to entirely cut out the balancing coils when the machine was carrying this load. The balancing coils were then cut out and the dynamo gradually loaded down to test the performance without balancing coils. The brushes were shifted forward to prevent sparking as the neutral point changed, and the potential was kept up as much as possible by cutting out field rheostat. The maximum current reached was 37 amperes at 85 volts, with field rheostat all out, and speed 1,800 revolutions per minute. At this speed, and with this excitation, the machine would have given 120 volts, instead of 85, if the balancing coils had been used to prevent armature reaction. After a load of 37 amperes was reached, it was found impossible to raise the current by cutting down the external resistance, owing to the rapid fall of potential due to armature reaction. The capacity of this particular machine was about doubled by the addition of the balancing coils, and a comparison of the 37 amperes maximum with the 80 amperes which was by no means the highest possible current, shows that the overload capacity of this machine may be doubled by their use.

Two more machines of the same general design as the latter were built and tested. These machines were built with field magnets of mitis metal, and the pole-pieces and armature cores were one inch longer than the machine last described. The armature windings were different from each other and different from the cast-iron machine. One was wound with a two-circuit winding, and the other with a four-circuit winding. Total weight of each machine was 450 pounds. Each machine, after running at 1,200 revolutions per minute, carried a load of 85 amperes at 110 volts for two hours continuously, and was then loaded down to 100 amperes for a quarter of an hour. The performance of the machines confirmed in every particular the results previously obtained.

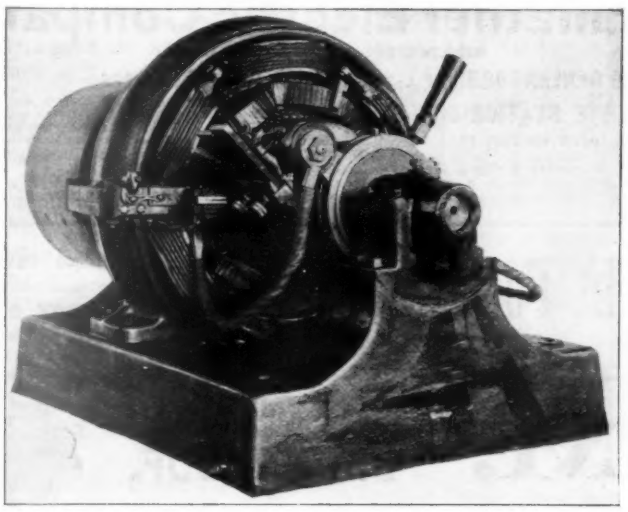

FIG. 19.

Two other machines of this same type were built—one of which was wound for a current of 10 amperes at 600 volts, and the other for a current of 550 amperes at 110 volts, or 60 kilowatts.

This type of machine was found to be expensive to construct, and owing to its exceeding compactness, very hard to ventilate. The main plan in view when designing these machines was to lessen the total weight for a given output by taking advantage of the fact that when the balancing coils are used, one may greatly increase the amount of copper on a given armature, and still obtain the same satisfactory performance at the commutator. As Fig. 15 indicates, a too compact design was adopted; the ventilation was cut down so that full benefit of the large amount of armature copper was not obtained.

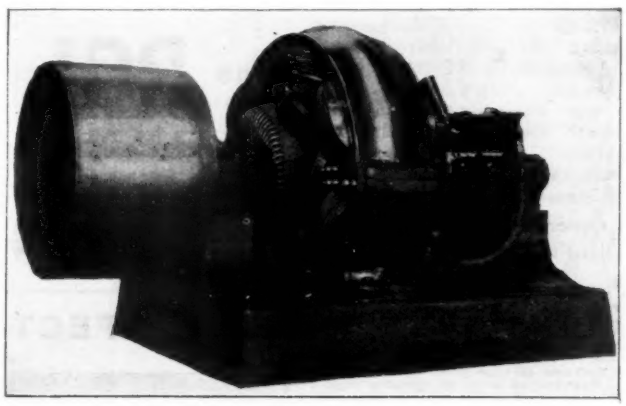

FIG. 18.

Machine No. 7 was therefore built with a field of the ring type. This machine embodied a number of important improvements in details of construction, as will be hereafter noted. Fig. 18 shows a photograph of the machine from the pulley end, and Fig. 19 is a view from the commutator end. Fig. 20 is a view of the armature which was wound with No. 6 wire cable. Both commutator and armature core were hollow and the winding thoroughly ventilated. All armature coils were wound simultaneously, and the winding was perfectly symmetrical.

(To be continued.)

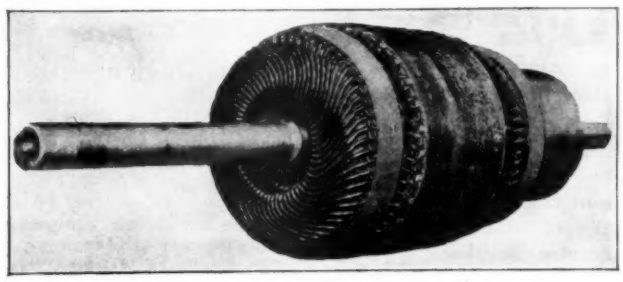

FIG. 20.

Telephone War in Kansas.

There is a lively telephone war in progress in Topeka, Kas., which is being watched with a great deal of interest by the subscribers to both the Bell and Harrison exchanges. The Harrison company started in Topeka last October with rates of $24 per year for residences and $36 per year for business houses. Recently the Missouri & Kansas Telephone Company announced new rates in Topeka for Bell service at $18 per year for residences and $24 for business houses, a reduction of 50 per cent. The Harrison company has announced that its rates, too, would be cut to $24 and $18 a year from $36 and $24. This cut was to take effect on April 1. The Missouri & Kansas Telephone Company will make a general reduction of 25 per cent outside of Kansas City and St. Joe.

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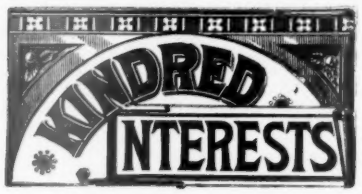

The Jos. Dixon Crucible Company, Jersey City, N. J., have issued a very appropriate calendar blotter for April.

The contract for constructing electrical subways in Baltimore, Md., has been awarded by the city to the Western Electric Company, of New York and Chicago, at $36,779.85.

The Electrical and Mechanical Engineering and Trading Company, 39 Cortlandt street, New York, has changed its name to the Electrical and Mechanical Engineering Company. J. H. Vail is president and chief engineer of the company.

The Fontaine Crossing and Electrical Company, of Detroit, Mich., are putting on the market an extensive line of electrical ventilating apparatus. They make Fuller's patent combination fan motors from 18 inches to 96 inches in diameter, wound for from 110 volts to 500 volts.

The Mather Electric Company, of Manchester, Conn., have secured, through Mr. J. Holt Gates, of Chicago, their Western contractor, the order for five 100-kilowatt multipolar generators, with station equipment, for the new station of the Indiana Electric Railway Company, at Goshen, Ind. This contract was secured against strong competition.

The National Telephone Company, of Boston, are doing a tremendous business in their latest types of instruments, which are meeting with the most flattering success in all sections of the country. Their Pony National instrument, which has just been put on the market, is without doubt the most powerful thing of the kind yet introduced, and marks a progressive step in the art of telephony. Among recent orders booked by the National company is one for 150 instruments from the Topeka Harrison Telephone Company, of Topeka, Kansas.

The Walker Manufacturing Company, Cleveland, Ohio, have closed the following contracts between March 1 and March 22, 1895:

Burhorn & Granger, No. 136 Liberty street, New York city, two 25-kilowatt direct coupled lighting generators; F. E. Snow, receiver Adrian City Electric Belt Railway Company, Adrian, Mich., one 60-kilowatt belted generator, three 25 horse-power single equipments; Union Depot Railroad Company, St. Louis, Mo., 41 double car equipments, 82 30 horse-power steel motors; Pittsburgh Traction Company, Pittsburgh, Pa., one double car equipment, two 30 horse-power steel motors; Pittsburgh, Crafton & Mansfield Passenger Railway Company, Pittsburgh, Pa., one double car equipment, two 50 horse-power steel motors; Federal Street & Pleasant Valley Passenger Railway Company, Pittsburgh, Pa., two double car equipments, four 30 horse-power steel motors; Suburban & Rapid Transit Street Railway Company, Pittsburgh, Pa., one double car equipment, two 25 horse-power steel motors; Schuylkill Electric Railway Company, Pottsville, Pa., four double car equipments, eight 25 horse-power steel motors; Chicago City Railway Company, Chicago, Ill., 49 double car equipments, ninety-eight 25 horse-power steel motors.

The General Electric Company has received the following letter:

CONCORD, N. H., February 8, 1895.

GENERAL ELECTRIC COMPANY.

Gentlemen—We have had our triphase plant in operation, as you know, since September, 1893, in which month we started the first triphase induction motor operated, for commercial work, from a central station in the United States.

We now have over 400 horse-power in motors and over 6,000 incandescent lamps in operation from our two 250-kilowatt generators.

It is four miles from our station, at the Sewalls Falls, where we have developed over 5,000 horse-power, to the center of the city of Concord. The voltage at the city is 2,200 on the primaries and 110 on secondaries. The loss between the generators and transformers is seven and one-half per cent on the heaviest load we have ever had.

The generators were put into service, running continuously, with the exception of one and one-half hours shut down every Sunday P. M. for cleaning up, and have never given us one minute's trouble, from any cause.

We use the type F transformer, and with the single exception of having a primary coil open in one, these have proved satisfactory.

The motors are volumes of credit to the system.

After having the vexation of commutators, sparking brushes, burned out armatures, coils and starting boxes, to contend with in our old 500-volt circuit, their absence, with no corresponding annoyance attending, is a relief that words cannot express. The motors start promptly with load, and their speed is almost absolute, varying less than two per cent from load to running free. The motors and lights are run from the same transformers, and starting a motor does not affect the lights any more than starting lights, which took the same amount of current, would. We experience no difficulty in balancing our circuits, and a difference of loads between two sides of 25 per cent is not noticeable in any way. We are operating heating and cooking apparatus, as well as laundry and tailors' irons, with great satisfaction to our patrons and selves.

We investigated all the known systems before we decided to place our order with you, and with our experience, if we were to put in a similar plant to-day it would be the *three-phase*.

Yours truly,
CONCORD LAND AND WATER POWER COMPANY,
(Signed) Eugene F. Carpenter,
Superintendent and Electrical Engineer.

STEAM ENGINEERING

(Stationary, Locomotive or Marine); Mechanics; Mechanical Drawing; Electricity; Architecture; Architectural Drawing and Designing; Masonry; Carpentry and Joinery; Ornamental and Structural Iron Work; Railroad Engineering; Bridge Engineering; Municipal Engineering; Plumbing and Heating; Coal and Metal Mining; Prospecting, and the English Branches. Students make rapid progress in learning to Draw and Letter. The Steam Engineering course is intended to qualify engineers to secure Licenses. Send for Free Circular, stating the subject you wish to study, to

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THE PERFECTION DYNAMO BRUSH

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FLEXIBLE, REDUCES SPARKING, SAVES COMMUTATOR.

Elegantly made. Try them. Woven Wire. Pure Copper.

MANUFACTURER
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